NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST

BULLETIN NO. 16

SHADE TREES FOR NORTH CAROLINA

BY

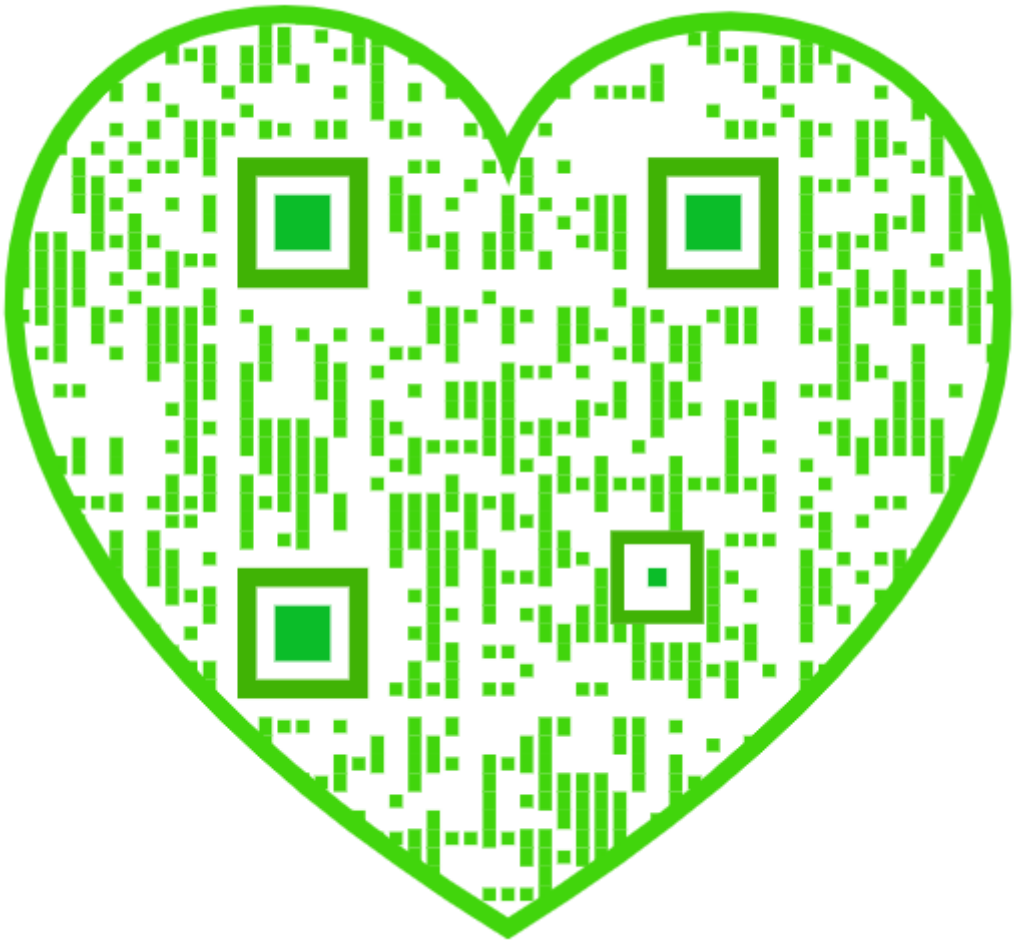
W. W. ASHE

FORESTER

RALEIGH

E. M. UZZELL & CO., STATE PRINTERS AND BINDERS

1908



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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., January 1, 1908.

To His Excellency, HON. ROBERT B. GLENN,

Governor of North Carolina.

Sir.—I herewith have the honor to submit for publication as Bulletin No. 16 of the reports of the North Carolina Geological and Economic Survey a report on Shade Trees for North Carolina by W. W. Ashe. This bulletin has been prepared especially for distribution in North Carolina.

Yours respectfully,

JOSEPH HYDE PRATT,

State Geologist.

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PREFACE

In the following report on Shade Trees for North Carolina, it is the desire of the Geological and Economic Survey to arouse within the State a more thorough appreciation of the necessity and beauty of shade trees on the streets of our cities and towns. To this end, descriptions are given of the majority of the shade trees suitable for street and park planting in different sections of the State and illustrations have been used to show more effectively the advantages to be derived by a town or city through the judicious planting of suitable trees on their streets. Many towns now realize that shaded parks and streets bordered with neatly kept rows of trees are an asset of very great value. In many instances where a town is without such shade trees it has begun to plant them and the present bulletin will be of considerable assistance to such towns in the selection of the proper trees for planting, the suitable time of year to set them out, and how to care for them and protect them from disease and insects. Various combinations of trees that grow well together and harmonize with each other are given and also suggestions regarding combinations of trees to give pleasing effects of color in the spring when the trees are flowering and in the fall when the foliage is turning. To the person who is interested in tree planting for his own yard, the bulletin should be of some considerable value inasmuch as it goes into detail in regard to the transplanting and pruning of trees.

A short chapter is devoted to Arbor Day and it is hoped that the bulletin will be the means of promoting a more general observance of this day in the State, especially in the public schools, which will thus inculcate in our school children a love for our trees, and as they grow up, they will appreciate not only their beauty but also their real value to the place in which they may happen to live. One of the customs of Arbor Day is the planting of trees and if but a few trees are planted each year by each school throughout the State, it will mean that a great many portions of the State will in a few years show most strikingly the advantage of systematic planting.

This report has been prepared by Mr. W. W. Ashe, Forester of the Geological and Economic Survey, who is most competent to treat this

subject. The Survey desires that any town or city or individual who wishes information regarding their shade trees or assistance relating to their care and protection will correspond with this office, as it is our desire to render every assistance possible.

JOSEPH HYDE PRATT,
State Geologist.

GOTHIC ARCHES OF ELMS. FOUR ROWS. GREEN STREET, AUGUSTA, GA.

SHADE TREES FOR NORTH CAROLINA.

By W. W. Ashe.

INTRODUCTION.

Shade trees should be regarded as a necessity on the streets of the cities and towns of North Carolina. They lessen the heat and glare of the long hot summer days without checking the cooling southern breezes, and filter from the air a large portion of the dust which rises from the streets and roads. Nor must their aesthetic qualities be overlooked. Towns fortunate enough to have shaded parks and streets bordered with neatly kept rows of trees possess an intrinsic asset. Many towns in North Carolina derive a large portion of their income from summer or winter visitors and the street tree contributes not a little to producing the conditions most agreeable to these guests.

It is very important to consider, in making a choice of a shade tree, its adaptability to the conditions and fitness for the purposes for which it is to be used. It is necessary to choose only those species which are suited to the local soil and moisture conditions. This does not by any means restrict the choice to local species. Some of the most desirable species are introduced either from other parts of the United States or from other countries. But, until a tree has been thoroughly tested by trial and its capacities and limitations locally determined, it is preferable to avoid its use as a street tree. The best success can generally be obtained from some of the well known native species and, on account of their great number, it is exceptional when most satisfactory results cannot be secured by their use. Only a few species thrive under the artificial conditions which exist on paved streets. In most species such situations are too unnatural, though they may be healthy trees and well suited for unpaved streets as well as for roads and parks. In many localities the existence of insect pests or destructive diseases prevent the use of what might otherwise prove most desirable trees. Even when a species may be able to grow on a paved street, other conditions may determine its unfitness. For example, only forms with narrow crowns or ascending branches, or small species, are adapted to narrow streets or when the buildings impinge closely upon the planting line.

Species with greater spread of crown can be used to advantage only when there is ample space for their development. Some species, while admirably suited for formal avenues or use in parks or on estates, or even for central planting in broad parking strips, are unsuited, on account of their habit or exacting requirements, for general street or row use. In one case, as along a macadam road, an early leafing and dense foliaged species may be desirable. Its shade will tend to preserve the moisture in the road bed and thus maintain it. On an unpaved earth road or street which tends to remain muddy, a thin foliaged species whose leafage appears late will be more serviceable. Although evergreens are seldom desirable on highways, their use may be found appropriate in certain towns used as resorts where it is necessary to secure green foliage during the winter.

Every condition which can in any way affect a tree should be considered before it is accepted for extensive planting in any locality, or before it is used under a condition in which it has not already been previously given full trial and found satisfactory. Trees on streets, roads and in parks and other public grounds are not of temporary interest. They are largely planted for the future and, if judiciously selected, rightly planted and carefully attended, their period of usefulness and range of beauty may be prolonged throughout several generations. The elms of New England, the maples and buckeyes of New York and the Middle West, and the oaks of the South, which constitute the chief attraction of the streets of many of the small towns, are the product of several decades and the men who planted them frequently failed to see them attain their glorious perfection.

Native species, whose health, longevity and value have already been tested and are fully known, are usually the best subjects for planting; and it is likewise true that local-grown material, when nursery raised, is usually more suitable than that from a distance. In all cases trees should be accepted only from firms whose stock has recently been inspected by authorities of their respective states for dangerous insects and destructive diseases; and no consignment, even when shipped under the inspection certificate, which shows traces of disease or is infested with injurious insects, should ever be accepted.

TIME TO PLANT.

When the choice of a species has been made and its suitability for local conditions determined, material for planting should be secured that it may be ready for planting at the proper season. At the same time the

holes should be properly placed and if the situation will permit, they should be dug. It is not uncommon to see a large proportion of nicely shaped and apparently thrifty young trees die the first season after planting either because the planting was not properly done or was made at an unfavorable season. Throughout North Carolina early spring is the time when successful planting is most assured. Fall planting is extensively advocated in the north, but the conditions in the southeast are not at all favorable for rooting at this season. Not only is the weather so warm and dry during the autumn that the roots are likely to dry while material is in transit, but the low rainfall period which terminates the long, warm, dessicating summer and autumn, leaves the soil too deficient in moisture to assure a renewal of root growth before winter, even though the specimens are well watered when set out.

Planting can begin, however, very early in the spring, the opening of the maple buds usually marking the beginning of the planting season. Its earliness varies in different portions of the State (if the unfolding of the maple buds is taken as the index) from the last of February in the southeastern portion of the State to the middle of March in the higher mountains. Planting can be continued until the leaves are nearly grown, but further delay lessens the chance of success. A few species are exacting in regard to the time at which they must be planted. Most of the deciduous, broad-leafed trees—oaks, elms, lindens, maples, and true poplars, and others which have numerous fine, fibrous roots—can be planted at any time during the spring with every assurance of success. A few species, however, are more exacting. The magnolias, including the cucumber tree, large-leaved magnolias, as well as the evergreen species and the closely related yellow poplar or tulip tree, require transplanting very late in the spring, just at the time when the buds are beginning to open. These trees are deficient in fibrous roots, most of their roots being thick and fleshy. Unless moved just at the time when root growth is taking place, success is doubtful. The black gum also requires to be handled in late spring; and all evergreens, both broad-leafed species like the holly, bays, mock orange, and evergreen oaks, as well as the coniferous evergreens, the pines, cedars and firs, are best moved late in the spring just before the period of active growth begins.

METHOD OF PLANTING.

Holes for planting should be prepared in advance of the proposed planting time so that when the season is favorable there will be no cause for delay. More or less care is required in the preparation of the holes according to the natural fertility of the soil and its adaptability to tree

growth. The more unfavorable the conditions and the poorer the soil the greater care should be taken in its preparation. For park and estate planting, where the roots of the tree have ample room for spreading, a hole 3 feet square and 2 feet deep is ample for small trees. If the soil is naturally of only fair quality, the top layer should be placed in a separate pile from the raw subsoil, and should be well mixed with leaf mold, if such is available, and placed in the bottom of the hole as a bed on which to place the tree. A portion of the subsoil should also be mixed with leaf mold, or, if this is not available, well decomposed manure, or litter, can be substituted, and used for filling the hole about the newly planted tree. A tree planted in such a manner will make rapid and sustained growth, and while under the best conditions such care and expense are not necessary, the excellent health of the specimen will usually compensate for the additional cost. As the conditions for tree growth become less propitious, as along the paved streets of towns where the soil moisture is frequently insufficient, the greatest care must be exercised if healthy, vigorous specimens are to be obtained. On paved streets, where it is desired to secure ultimately large specimens, the planting hole can well be made even larger than 3 by 3 feet, either by increasing the width on all sides or extending one side so as to have the greatest length paralleling the curbing. The earth in all such cases, unless naturally very fertile, should have well decayed leaf mold or litter added to it in the proportion of about one-third.

The most essential requirement for the healthy growth of trees, so far as the roots are concerned, is a uniform, though not excessive supply of soil moisture. Some soils, on account of their situation or character, are naturally more subject to drying than others. The addition of the well rotted leaf mold to such soils not only adds a store of easily available plant food, but greatly increases their water-carrying capacity, enabling them to store large quantities of rain water for the future needs of the tree. At the same time, soils which are wet are apt to be sour, especially when heavy clays, and this condition is fully as unfavorable for healthy growth as when there is a deficiency in the moisture supply. Such sour soils are usually compact clays and it is often difficult to properly underdrain them. Slow and unhealthy growth and small yellowish foliage are an excellent indication of a soil's being sour, if it is wet. The addition of a small amount of lime to the soil is a temporary corrective, although drainage is necessary for permanency. Pin oak, willow oak, red maple, black gum and sweet gum are more suitable for sour soils than other species. White oak, red oak, black oak, sugar maple, linden, yellow poplar and cucumber are intolerant of such conditions. The addition of

woods litter facilitates the drainage of such a sour soil. The hole, however, under such conditions, should be several inches deeper than would be required in a lighter and more porous earth.

Specimens should also receive careful attention previous to planting. When shipped from a distant nursery, they should be unbundled, and if a long period, as of several weeks, is to elapse before planting, they should be heeled in. This is done by digging a trench one side of which is very sloping, and the depth of which is from 18 inches to 2 feet, according to the size of the trees. The specimens should be distributed along this trench on the sloping side, the roots spread, the trench re-filled and the earth firmly packed. If a suitable, cool shady place is selected, as on the north side of a building, or at the base of a north sloping hill for heeling in, leafing can be deferred for several weeks after the normal time for opening. When it is necessary to keep specimens for only a few days before planting, they can safely be placed in any cool, shady place—a cellar being an excellent place. Care should be taken, if the weather is warm, to lessen the danger of the roots heating by opening the bagging or straw in which they are wrapped. On the other hand, if the weather is cold, precautions must be taken to prevent the roots from freezing and becoming dry. They will seldom freeze in a deep, well-walled cellar, or they can be covered with straw. When planting time comes the roots of the trees which are unpacked, or taken from the heeling-in trench, should be puddled by dipping in a thick mud until well coated. During windy or warm weather the roots should be given additional protection, after unpacking for planting, by covering with sacking and having an occasional bucket of water thrown over them. The better the condition of the roots when the tree is planted and the larger the number of live fibrous roots the greater is the probability of rapid growth.

In the selection of specimens only those should be chosen which have reasonably straight stems and well-formed crowns. The larger the specimen, the better developed and more shapely should be the stem and crown. Crooks in the stems of very small trees are soon out-grown, while pruning soon corrects juvenile deformities of the crown. Such defects are more slowly corrected in larger specimens. It is also necessary to see that the roots of specimens are in good order. Before planting these should be pruned with a sharp knife and the broken roots removed. Very large scars of this kind, or large root wounds, especially in species with thin sapwood, where the heart is exposed, should be well painted with either a coal tar or a thick linseed oil paint. This will lessen root rots which frequently ascend and result in hollow stems. The crown and stem should also be pruned at the time of planting. It is necessary, in the

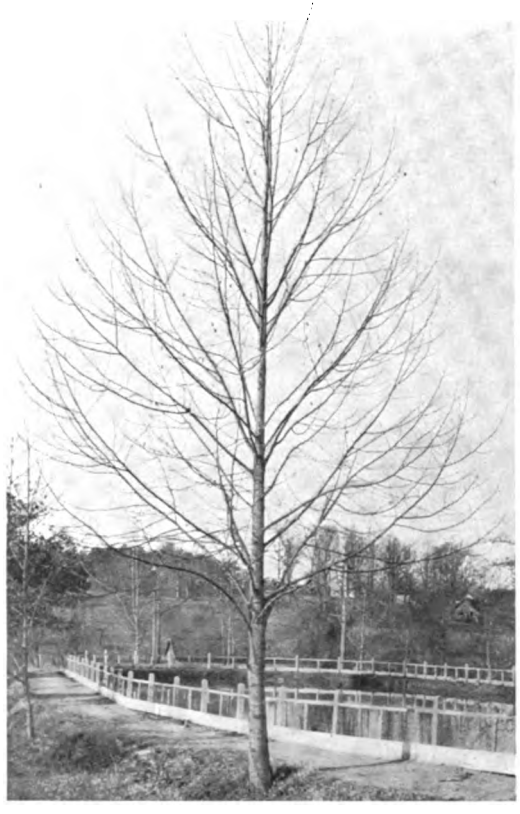
first place, to reduce the size of the crown to compensate for the reduced root surface. This is far more necessary in forest-grown specimens, the roots of which are frequently badly mutilated in lifting than in nursery-grown stock, the roots of which are more compact and better provided with fibrous rootlets. The severity of pruning required varies with the species. Easily rooting species, like willows, true poplars, elms, and maples, usually require, if nursery-grown stock, only a slight reduction in the crown surface; while those species that root more slowly, as the oaks, magnolias, yellow poplar, cucumber, hickories and walnuts, require considerable crown-pruning.

Crown-pruning, no matter how severe, should, in general conform to the shape the tree is to assume. Species which form deliquescent stems like those of the elm or maple (see Pl. IV, A) can be topped, but the topping should take place at the height at which it is desired to form the base of the crown. Species which do not produce deliquescent stems, but whose growth is excurrent, consisting of a central shaft from which subordinate branches spring, like that of the yellow poplar (Pl. II, A), should generally not be topped at all. Topping of such species as these is likely to result in the formation of several stems or a forked stem and irregularity of shape. It is a better practice to confine the pruning of trees of this class to the removal or partial removal of lateral branches and not to cut back the main leader at all. The base of the crown is determined in trees of this class subsequent to planting, by the removal of the lower branches. See also Pl. V, A.

It is usually preferable to plant small trees from ½ to 1 inch thick, at the height of a man's shoulder, and from 6 to 8 feet in height. The cost of handling trees of this size is much less than that of larger stock; they can usually be removed with far better roots than larger trees; and on account of their more rapid growth, they frequently outgrow larger trees whose roots are not so well preserved.

SUN SCALD OF YOUNG TREES.

Small trees whose stems have been shaded, as those from very close nursery rows, and forest-pulled specimens, especially of the sun-tender species with their smooth bark, are subject to sun scald. This results from the killing of the cambium or inner bark on the southern or southwestern side of the tree by the heat of summer and autumn suns. The first indication of sun scald is the cracking of the bark in vertical, and then in cross seams, as it becomes dry and brittle. In the later stages it frequently peels off or curls up in long strips, exposing the sapwood, which



A. YOUNG TULIP POPLAR SHOWING PYRAMIDAL SHAPED CROWN AND UNDIVIDED STEM.

B. BAD PRUNING AND NEGLECT. ONE-HALF OF THE TRUNK IS DEAD FROM SUN-SCALD. THE CROWN IS FILLED WITH PARTIALLY DEAD STUBS FROM WHICH THE BARK HAS FALLEN, CAUSED BY BAD PRUNING. THE SWOLLEN RING JUST BELOW THE CROWN SHOWS BAD PRUNING WHEN THE STEM WAS LENGTHENED.

soon dries and seems dead. The blisters from sun scald frequently extend from near the ground to well within the crown of the tree, and in the worst cases a scar is left covering the entire southern half of the stem, there being no living wood within the scar (Pl. II, B). Sometimes in very small, rapidly growing trees these long scars, will heal over by growth from the edges of the bark surrounding the wound. More frequently they never heal, but sapwood decays on the scar and a hollow forms in the trunk of the tree.

The species most subject to sun scald are those with thin, smooth bark, especially those which naturally grow in dense, shady woods, as maple, beech, linden, tulip poplar, and some of the magnolias; while the oaks, elms, and ashes are seldom affected. As trees, even of the tenderest species, become older and the bark becomes rough, they lose their sensitiveness and no longer sun scald. Small trees of tender species, unless they have been hardened by being grown in open nursery rows, require a shade protection on the southern sides. When a guard of wooden slats is used, that is sufficient. When no slat guard is used, a cheap triangular shade guard can be made of one solid, vertical board, which is placed to the south side of the tree. A few rows of horizontal slats form the two other sides, being nailed where they meet to a vertical post (Pl. IV, A). This guard should be anchored securely by means of stakes driven deeply in the ground, to which it is nailed. The tree, as has been explained, should be fastened to it by leather or cloth bands across the top to prevent rubbing. A guard of this kind is preferable to wrapping the stem with straw or sacking.

Wounds resulting from sun scald should be treated like other wounds. The loose and diseased portions of bark, under which the inner bark has darkened or discolored, should be cut away until healthy tissue is exposed around the entire wound. The surface of the exposed wood and the edge of the living bark should be well covered with a linseed oil paint and the stem of the tree suitably shaded to prevent further extension of the injury. In case further blistering takes place the dead bark should again be cut away. Such a wound, though large, will, if carefully managed, heal on a small tree.

Suckers frequently appear from the base of trees which have been badly sun blistered. They should be removed at once. Sometimes, following very heavy pruning, which admits direct sun-light, sun scald takes place on the upper part of the trunk which has been exposed. Such wounds should be cared for as suggested, and heavy crown pruning subsequently avoided for such species.

PROTECTION AFTER PLANTING.

Small trees along streets and roads should be protected by a guard of some kind, either like that described for protecting from sun scald or similar to one of those described below. Trees eight inches or more in diameter which are too large to box and yet require protection from biting or rubbing of animals or mutilation of other kinds can be protected by wrapping about the lower part of the stem a piece of small mesh galvanized wire netting. The netting should be 6 feet or more wide, the lower selvage dropping to within a few inches of the ground. The raw edges should lap several inches, permitting loosening and readjusting with the growth of the tree. The netting should hang loosely from short wires fastened to staples driven into the trunk a few inches above the upper selvage. More ornamental guards made of wrought iron can be purchased. They are only suitable for small trees and are no more serviceable than those made of wood. A four-sided box 5 or 6 feet high and several inches larger at the base than at the top, made of narrow vertical slats, is not only a cheap but a durable and satisfactory guard. All guards and the bands fastening them to the trees should be examined at frequent intervals, especially after heavy storms to prevent the bark being seriously rubbed or cut by them. Deep abrasions from rubbing not only cause permanent disfigurement but often greatly impair the health of the specimens. Hitching rings or sign boards should not be fastened to trees nor should light, power or telephone companies be permitted to anchor poles to them by girdling them with wire.

PRUNING.

Time to Prune.—Small branchlets of broad-leaf trees can be removed at any season of the year. The bark on such branchlets is growing rapidly and the wound will usually heal during the following spring.

Large, live branches, whether cut close to the stem or partially removed by cutting at some distance from it, should only be pruned during late autumn, winter or early in spring before the sap is active.

Small Branchlets are removed or pruned with a knife, shears, tree pruner or sometimes with a saw (figs. 6, 7, 8 and 9). The cut should be clean and smooth and made without tearing the bark loose from the wood below the cut. When a branch is removed from the stem, no matter how small the branch is, the cut should be as close as possible to the bark of the stem (figs. 1 and 2). Very small branches in the crown, which are merely cut back in pruning for shape or to secure thicker foliage, can be cut at any convenient point, but larger branches should be cut only at the point where they leave the stem or another branch.

FIG. 7.

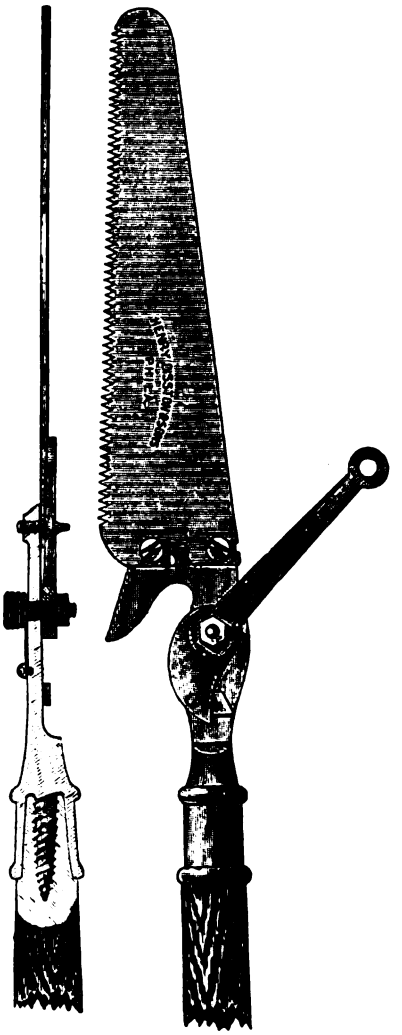


FIG. 8.

FIG. 9.

FIG. 7.—Pruning saw for heavy work.

FIG. 8.—Pruning hook and saw. Can be used either with or without pole. Saw blade is quickly removed and the pole shears can be used alone. Shears can also be secured without the saw.

FIG. 9.—Adjustable pole pruning saw. Adapted for sawing by hand or attached to a pole. The handle, which has a socket for use with pole, is adjustable for convenience of using at different angles. Blade 18 inches long.

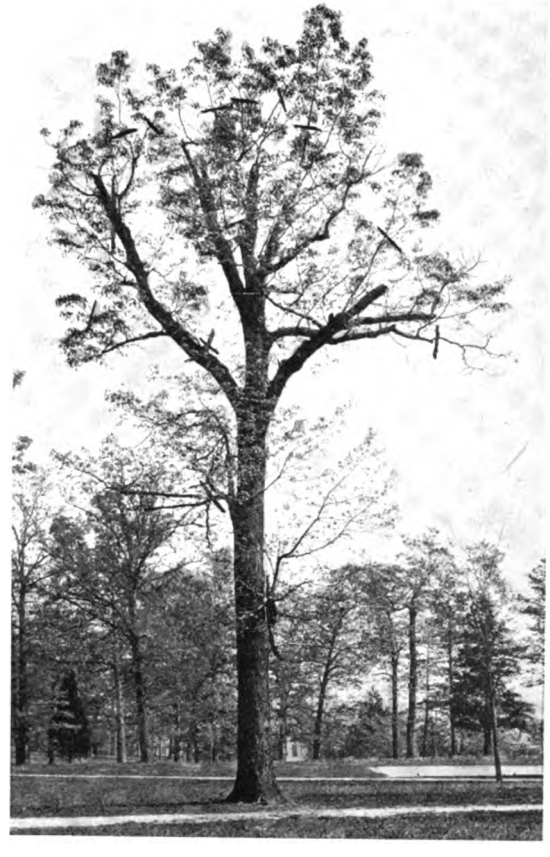
naturally broadens considerably with age with most species which have deliquescent stems. After the height growth is made, the vitality of the tree is expended in extending the lateral branches, changing the shape of the crown from oval or conical in early youth to broadly oval in middle age and dome-shaped in old age. For this reason in mature trees which are not over high more lateral trimming is usually advisable than trimming in the apex of the crown.

Trees whose boles are unduly long in proportion to the crown should be topped. The topping, accompanied with a small amount of lateral lopping, will frequently force the development of shoots on the upper part of the bole from dormant buds. It is advisable to permit the growth of these shoots since they assist in lowering the center of gravity, trees of this kind being top heavy and likely to wind fall. Many of the old oaks and hickories forming parts of groves on public grounds, parks, etc., which were originally forest trees, are of this class, being tall and having the boles too long in proportion to the length of the crown, which, moreover, are very wide-spread (Pl. V, B). As their comrades have died, they have been left isolated and unprotected from the wind, while their tall stems and large crowns make them liable to windfall, which has still further thinned them. On account of the freer entrance of wind and sun the ground becomes very dry and the tree begins dying in the upper part of the crown. When the soil of such a grove has become decidedly deficient in humus, either from the burning of the leaves and grass annually or because the leaves are removed, cultivation for several years and the plowing under of one or two crops of cow peas, or clover will be of great benefit in re-establishing the conditions necessary for healthy growth. In figs. 6, 7, 8 and 9 are illustrated various tools that can be used to advantage in pruning different trees.

CARE OF NEWLY PLANTED TREES.

For some weeks newly planted trees should be watered regularly, if the soil is very dry, and subsequently if droughts occur during the summer and autumn of the first season. Usually trees will be well rooted by the end of the first growing season so that watering will seldom be required in subsequent seasons. The earth around the tree should be cultivated once or twice a season for several years to assist in the preservation of soil moisture and to add to the permeability of the soil so that all of the rainfall will be absorbed. Mulching with straw or grass cut from lawns will also tend to maintain the soil moisture. Young trees, however, should not be mulched with manure for the first few years at least and, if the soil has been properly prepared, they will not require it.

A. WATER OAK THE SECOND YEAR AFTER PLANTING. SUCH HEAVY TOPPING ENTIRELY ALTERS THE NATURAL SHAPE OF THE CROWN IN MANY SPECIES AND RETARDS GROWTH SEVERAL YEARS.



B. STAG-HEADED TREE. THE TRUNK IS TOO LONG FOR THE SIZE OF THE CROWN. THE CROWN SHOULD BE LOWERED BY PRUNING AS INDICATED BY LINES. THIS TREE IS ALSO SUFFERING FROM GENERAL NEGLECT AND REQUIRES THE REMOVAL OF MANY DEAD LIMBS AND SWAYS, THE FILLING OF MANY CAVITIES AND THE REMOVAL FROM THE STEM OF THE LOWEST ADVENTITIOUS SHOOTS.

Large Branches.—In removing large branches entirely, the cut should be made just as close to the stem as possible, even cutting through some of the bark of the stem in making it. No limb should ever be cut in such a manner as to leave any neck, snag, stump or projection of any kind beyond the trunk of the tree. Large limbs which are only partially removed should be pruned back to a sound, vigorous branchlet which springs from it (fig. 3). Descarts has well called the branchlet which is left the sap lifter. It must be sufficiently large to maintain activity in the cambium between *M* and *N*, (fig. 3). This insures the early formation of a callus where the cut A-B was made, and the occlusion of the wound. If this sap lifter is not left, the cambium on the stub *M-N* dies,

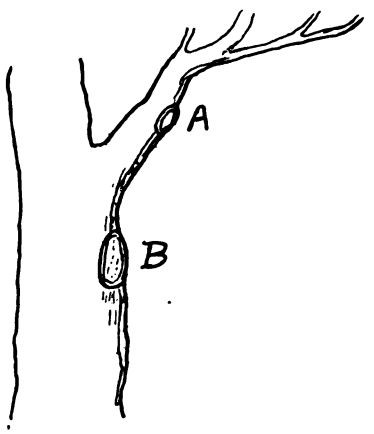


FIG. 1.

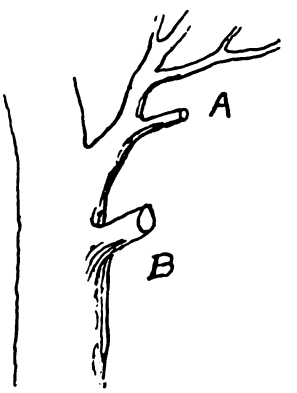


FIG. 2.

FIG. 1.—Correct way of removing a small branch *A*, or a large branch *B*. No stub should be left.

FIG. 2.—Wrong way of cutting a small branch *A*, or large branch *B*, where a stub is left. Such stubs die and produce hollows.

either entirely or back a considerable distance from its extremity, on account of the lack of circulation of sap through it. A callus then begins to form as a collar around or near the base of the projecting stub and gradually extends up the stub, sometimes, if the stub decays rapidly, completely healing over at the end but more frequently failing to close on account of the incurving of the callus into the hollow as it deepens (fig. 4). When this occurs, an opening remains at the end of the callus, forming a hollow, as shown in the right hand tree in the frontispiece, in which water collects, accelerating the decay already taking place in the wood of the stub, and gradually extending the decay of the heartwood of the tree below the hollow and to a slight distance above it. There is a

limit to the distance such a callus will grow, as circulation of sap must be maintained through it. After extending a certain distance beyond the direct line of sap flow, its growth becomes slow and finally almost ceases, being just sufficient to maintain a thin tissue of live inner bark on the callus. In willows and in those trees which form pollards, even large branches can be cut and sprouts will grow from the end of the stub, which will soon heal over. Other trees when young, among them the cork, elm and hackberry, can be pollarded to some extent.

All exposed wood of a wound more than an inch in diameter should be painted with coal tar. Since there is danger of large branches splitting and tearing the bark lose below the cut, it is better to cut them twice as shown in fig. 5. An undercut made with a hatchet or ax lessens the possibility of the bark being torn loose.

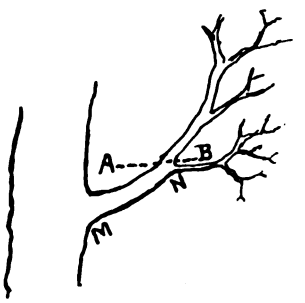


FIG. 3.

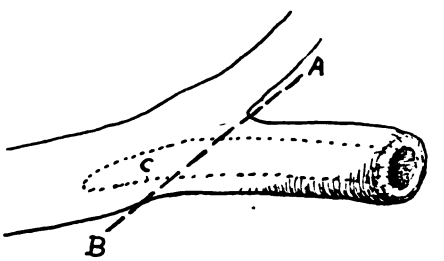


FIG. 4.

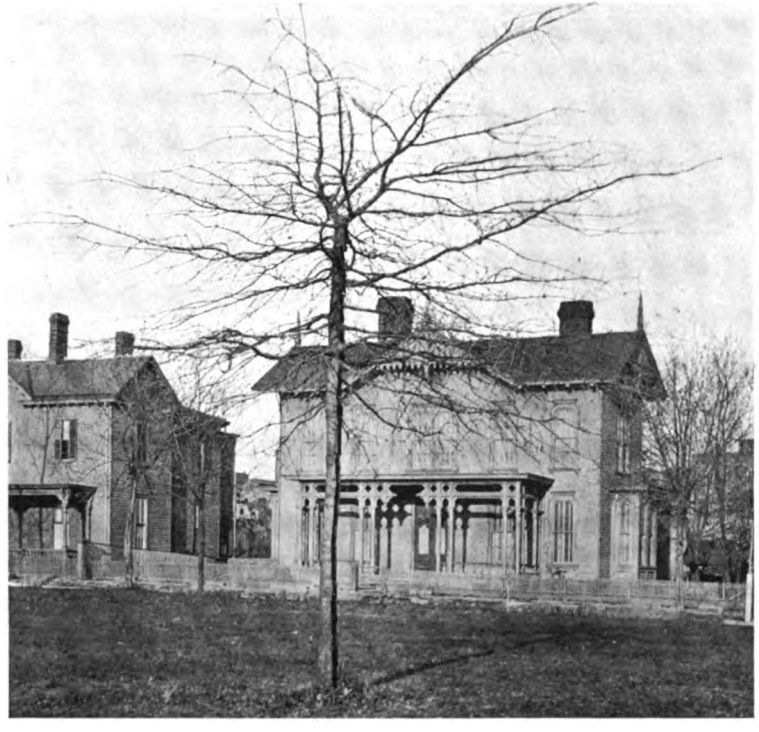
FIG. 3.—In pruning large branches, especially on trees which are past their youth, and whose powers of sprouting from cut branches is reduced, they should be pruned so as to leave a living branch growing from the end of the stub. This branch will usually maintain sufficient growth in the stub to cause the healing of the wound where the large branch was removed.

FIG. 4.—Hollow snags should be cut close to the live branch from which they spring, as at *AB*. If the hollow penetrates the live branch it should either be filled with cement or with a wooden plug and painted, after the snag is removed.

PRUNING FOR SHAPE.

The crowns of newly planted trees frequently assume irregular shapes after a year or two of growth. Such irregularities are to be corrected by pruning the crown several years after permanent planting, when it is possible to determine what shape is being formed. After pruning to shape, the crown should be subsequently examined at intervals of three or four years and tendencies towards irregularity remedied, when they consist either in the prolongation or overgrowth of one or two branches, or in the formation of a shape different from that of other trees in the same line. All trees in the same line should have the same shape, or

A. WELL PLANTED MAPLE TWO YEARS AFTER BEING SET OUT. A SMALL SPECIMEN WITH GOOD ROOTS. ONLY SLIGHT CROWN PRUNING WAS REQUIRED AND GROWTH BEGAN AT ONCE. TREE IS BOXED TO PROTECT STEM FROM SUN-SCALD.



B. FLATTENED CROWN OF OAK, THE USUAL SHAPE ASSUMED WHEN HEAVILY TOPPED.

Slender trees, especially evergreens, should be firmly tied by means of leather thongs to stakes deeply driven into the ground. If it is necessary to protect the tree from animals or there is danger from sun scald, the tree should be boxed as is described on page 21. The necessary pruning of the tree should be done before it is planted. It should be examined several times during the first season to determine whether the specimen is suffering from drought, whether the stake support or guard is secure, whether there is rubbing of the fastenings, and whether there are present any insects like scales, which are very injurious. The subsequent health and vigor of the tree will amply repay such care bestowed upon it for the first few years after planting.

GENERAL SUGGESTIONS FOR STREET PLANTING.

In selecting trees for street planting the following points should be considered:

Width of walks and width of street.

Size of tree and shape of crown.

Ability to stand pruning where the tree cannot be permitted to attain full size.

Age the tree attains under the local conditions.

Freedom from disease; objectionable insects; fruit, either large or stony or attractive to birds; dropping of twigs; objectionable odors.

Suitability of tree to the local conditions of

Drainage or water supply,

Depth and quality of soil,

Available root area, space and shape of root system,

Smoke and chemical gasses from reduction plants, fertilizer factories, etc.

Date of leafing, of defoliation and winter habit.

Ornamental characters, flowers, color of autumn foliage.

The following trees are selected as being the most desirable for general street planting in towns and cities of North Carolina. When a tree is suited for only one or two sections of the State, the section or sections for which it is adapted are indicated by *E.* for eastern, *M.* for middle, and *W.* for the western portion; otherwise it may be considered as adapted to any part of the State. Trees having very large nuts, pulpy or juicy fruit or very objectionable qualities, have been excluded from this list, but will be found in the general list of shade trees. On account of the superiority of the trees in this list over other trees suitable for planting in this State, they will be referred to as standard shade trees.

STANDARD SHADE TREES FOR NORTH CAROLINA.

COMMON NAME.	BOTANICAL NAME.	DESCRIBED ON PAGE.
Ashes.		
Biltmore ash *W.*	*Fraxinus biltmoreana*	45
Green ash *M. E.*	*Fraxinus lanceolata*	44
White ash *W.*	*Fraxinus americana*	45
Swamp ash *E.*	*Fraxinus profunda*	44
Box elder	*Acer negundo*	56
Chestnut	*Castanea dentata*	61
Elms.		
Cork or small leaf elm *M. E.*	*Ulmus alata*	45
White elm	*Ulmus americana*	46
Ginkgo	*Gingko bilaba*	68
Golden bark willow	*Salix alba vitellina*	71
Hackberry *E.*	*Celtis mississippiensis*	46
Hop hornbeam	*Carpinus caroliniana*	62
Horse chestnut	*Aesculus octandra*	54
Kentucky coffee tree	*Gymnocladus dioica*	59
Lindens.		
European silver linden	*Tilia argentea*	53
Native lindens *M. W.*	*Tilia*	53
Maples.		
Norway maple	*Acer platanoides*	54
Red maple	*Acer rubrum*	55
Silver maple	*Acer saccharinum*	56
Southern maple *E. M.*	*Acer floridanum*	54
Sugar maple	*Acer saccharum*	55
Oaks.		
Black oak	*Quercus velutina*	67
Laurel oak *E. W.*	*Quercus laurifolia*	63
Live oak *E.*	*Quercus virginiana*	63
Pin oak *W.*	*Quercus palustris*	68
Red oak *W.*	*Quercus rubra*	66
Scarlet oak *M. W.*	*Quercus coccinea*	67
Shingle oak *W.*	*Quercus imbricaria*	65
Southern red oak or Spanish oak *M. E.*	*Quercus digitata*	68
Swamp chestnut oak	*Quercus michauxii*	66
Water oak *M. E.*	*Quercus nigra*	64
White oak	*Quercus alba*	65
Willow oak *M. E.*	*Quercus phellos*	64
Oriental plane	*Platanus orientalis*	69
Paulonia	*Paulonia imperialis*	43
Poplars.		
Bolle poplar	*Populus alba bolleana*	70
Carolina poplar *E.*	*Populus deltoides*	71
Lombardy poplar	*Populus nigra italica*	70
Necklace poplar	*Populus monilifera*	71

COMMON NAME.	BOTANICAL NAME.	DESCRIBED ON PAGE.
Sweet gum *E*	*Liquidambar*	57
Sycamore	*Platanus occidentalis*	69
Umbrella tree *M. E*	*Melia azedarach umbraculifera*	60
Yellow locust *M. W*	*Robinia pseudacacia*	57
Yellow or tulip poplar *W*	*Liriodendron tulipifera*	50
Yellowwood *W.*	*Cladrastis lutea*	61

Of this number the following are adapted for planting only on very wide streets, on parking strips or along avenues, and are not recommended for general sidewalk planting on account of their large size, and spreading crowns, unless it is expected to trim them to keep them in bounds: white oak, live oak, red oak, black oak, swamp chestnut oak, southern red oak (Spanish oak), tulip poplar, sycamore, oriental plane, sweet gum.

ORNAMENTAL TREES.

Partly in addition to the above, there are a number of species having showy flowers, some of which admit of use alone as standard shade trees as indicated by being included in the above list; most of them, however, are not well suited for use alone, but are preferably used in alternation with standard shade trees, or for centre planting.

ORNAMENTAL TREES HAVING SHOWY FLOWERS.

COMMON NAME.	BOTANICAL NAME.	COLOR OF FLOWER.
Lindens	*Tilia*	White or light colored.
Kentucky coffee tree	*Gymnocladus dioica*	"
Yellow locust	*Robinia pseudacacia*	"
Yellowwood	*Cladrastis lulea*	"
Catalpa (hardy)	*Catalpa speciosa*	"
Magnolia (evergreen)	*Magnolia foetida*	"
Cucumber tree	*Magnolia acuminata*	"
Mountain magnolia	*Magnolia fraseri*	"
Crape myrtle (white)	*Lagerstroemia indica*	"
Sourwood	*Oxydendrum arboreum*	"
Buckeye (white)	*Aesculus*	"
Rowan tree	*Pyrus americana*	"
Horse chestnut	*Aesculus octandra*	Red or pink.
Buckeye (red)	*Aesculus*	"
Mimosa	*Albizzia julibrissin*	"
Evergreen cherry	*Prunus caroliniana*	"
Redbud	*Cercis canadensis*	"
Crabapple	*Pyrus coronaria*	"
Crape myrtle (red)	*Lagerstroemia indica*	"
Paulonia	*Paulonia imperialis*	Lilac or purple.
China tree	*Melia azedarach*	"

Several of these have large, fleshy fruit and can only be used on central parking strips or where they would not overhang pavements.

AUTUMN FOLIAGE.

In addition to the flowers, the foliage of many species assumes in autumn bright hues which renders it attractive. While in individual specimens there is occasionally deviation from the usual colors, the following list shows the common autumn coloring:

Color of Autumn Foliage of Trees.

COMMON NAME.	BOTANICAL NAME.	COLOR OF FOLIAGE.
Maples	*Acer*	Shades of red and yellow.
White oak	*Quercus alba*	Shades of red.
Red oak	*Quercus rubra*	"
Swamp chestnut oak	*Quercus michauxii*	"
Dogwood	*Cornus florida*	"
Tulip poplar; tulip tree	*Liriodendron tulipifera*	Shades of yellow.
Black oak	*Quercus velutina*	"
Lindens	*Tilia*	"
Ashes	*Fraxinus*	"
Poplars	*Populus*	"
Hickories	*Hicoria*	"
Chestnut	*Castanea dentata*	"
Hop hornbeam	*Carpinus caroliniana*	"
Scarlet oak	*Quercus coccinea*	Tones of crimson.
Sweet gum	*Liquidambar*	"
Black gum	*Nyssa sylvatica*	"
Pin oak	*Quercus palustris*	"
Elms	*Ulmus*	Dull yellow or brown.
Willow oak	*Quercus phellos*	"
Sycamore and plane tree	*Platanus*	"
River birch	*Betula nigra*	"

OBJECTIONABLE TREES.

The Otaheite or paper mulberry is a very objectionable tree, as it is small, short-lived, late in leafing and suckers badly. The cultivation of the Ailanthus has been tried in several towns and it has been found unsatisfactory, both on account of the odor of the flowers of the male or staminate plants, and the abundance of its suckers. Catalpa is objectionable in localities where attacked by caterpillars. Tilia europea (T. parvifolia, etc.) is too small and short-lived.

ARRANGEMENT OF TREES ON STREETS.

Streets of ordinary width, from 60 to 90 feet, are usually best treated by the planting of a single row of trees down each side of the street on the outer edge of the sidewalk (fig. 11). Occasionally there are difficulties in the way of successfully placing even small trees on the sidewalks of streets narrower than 60 feet, as when the buildings are several stories high and erected on the property line. In such a case an arrangement with a single middle row like that in fig. 10 might be advisable, especially on streets running east and west, where the trees planted on the south side of the street would be very largely cut off from sunlight, while those planted on the north side would be bent towards the street. In some portions of the streets of Southport there is a single row of live oaks down the middle of the street.

Very wide streets often admit of more elaborate planting than a row of trees down each walk. A satisfactory way to treat a street 100 feet wide is a row on each sidewalk and a row on a narrow planting strip down the middle of the street (figs. 12, 13, 14 and 15). The principal streets of Columbia, S. C., are planted in this manner. The trees in the middle strip can either be standard shade trees of the same kind as the lateral rows or ornamental trees or standard trees alternating with ornamental trees.

Streets from 120 to 150 feet can have the plantings arranged in several different ways. There can be a double row down each of the sidewalks which can be very broad, the row next to the property line being of a standard shade tree and the row next to the driveway being either of the same species or an ornamental tree.

Another arrangement for a street of such width is one row down each sidewalk with a parking strip down the middle of the street with a double row of trees and a walk in the parking strip. Such an arrangement on a wide street gives a very handsome effect, as is shown in the frontispiece, a view of Green Street, Augusta, Ga. A yet wider street or one in which there is no need for such wide driveways can have a lateral row on each sidewalk and three or even four rows down a central parking strip, the central rows being standard shade trees of some size and dignity and the lateral rows carefully selected ornamental trees (figs. 16, 17 and 18).

Drives along streams or water fronts can also, when of some width, be planted in double or triple rows.

In each case a tree should be selected with due consideration for the width of the street and the distance between the houses and the planting line.

FIG. 10.

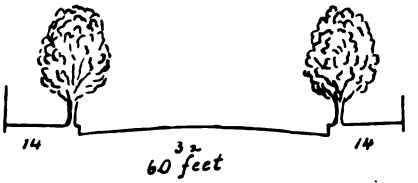
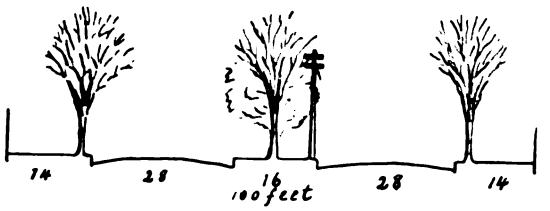


FIG. 11.



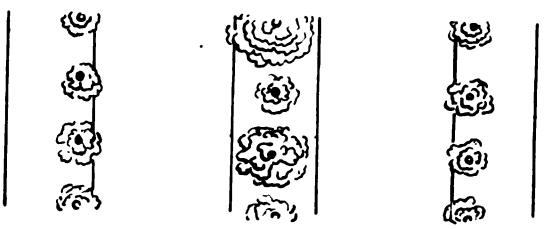
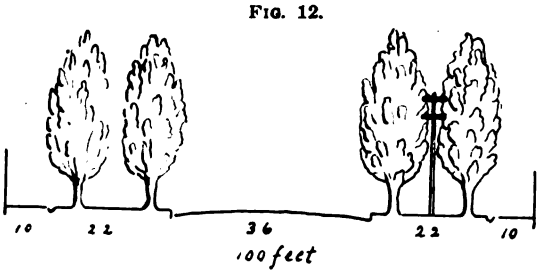


FIG. 12.



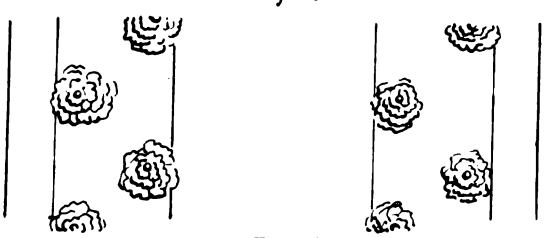


FIG. 13.

FIG. 14.

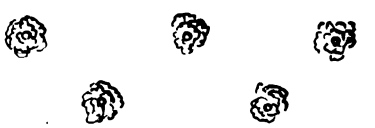


FIG. 15.

FIG. 10.—Street 65 feet wide. Single row of trees in middle. Ornamental trees can be alternated with standard shade trees.

FIG. 11.—Street 60 feet wide. Single lateral row of trees on each side, either standard shade trees; or standard shade trees alternating with ornamental trees, or with broad leaf evergreen trees.

FIG. 12.—Street 100 feet wide. Single lateral rows and single middle row. Ornamental trees; or ornamental trees alternating with the same standard shade trees used on the lateral rows can be planted in the middle row.

FIG. 13.—Street 100 feet wide. Double lateral rows, the trees in the rows arranged quincunxially or alternately.

FIG. 14.—Opposite planting.

FIG. 15.—Alternate planting.

Trees can be planted, when in double rows, either opposite each other or alternate in the rows. Alternate planting is better adapted for double rows on narrow planting strips since it permits the crowns to interlock in place of interfering.

ARRANGEMENTS OF PLANTINGS.

The usual practice of planting at one time the entire length of a street with the same species, all specimens of which are expected to reach maturity together, has some disadvantages. For a long period it is true the effect of the continuous uniform rows is faultless. The trees reach maturity about the same time, but they begin to decline irregularly, and each specimen is cut as it becomes necessary and a replant made. In this manner replanting extends over many years, and even though the same species be used for filling blanks, the original regularity will seldom again be attained.

When some formality is desired, it is best to make an original planting of two species, one selected for a permanent tree and the other a short-lived, quickly growing tree planted alternately with the permanent species. The temporary tree will soon furnish shade and give some character to the street. When it reaches maturity or at the end of a fixed period, all specimens of this temporary species can be removed, and specimens of the permanent tree planted in their place. This will give two sets of trees of the same kind, differing in age by a fixed period. The younger series will be in its maturity when the older series is declining. The older series can then be entirely cut and replaced without affecting the continuity of the tree line or seriously impairing the shade.

By initiating and strictly adhering to such a plan, the species could at any two cutting periods be entirely changed, if found advisable, and that without interfering with the appearance of the trees or with the shade.

The distance from the trees to the property line should be the same throughout the length of the street, unless the width of the walk changes. The spacing should be the same between all trees of the same kind so far as they extend on a street and should be determined: (1) By the species and the size and shape of its crown; (2) by the fertility of the soil, since the crown will attain smaller dimensions on poor than on fertile soils; (3) whether it is intended to permit the trees to attain their full size, as would usually be the case on parking strips, on wide walks, on residential streets where the houses are some distance from the property line, along wide avenues, river drives, etc. See figs. 16, 17 and 18.

For aesthetic considerations, plantings along a street should be of one species, which should give character and tone to it. While it is unneces-

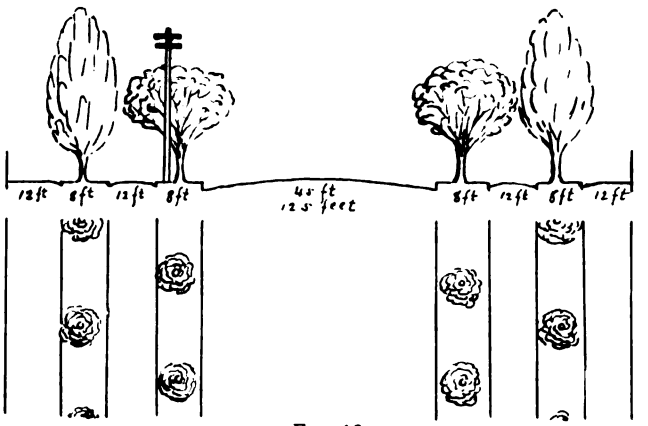


FIG. 16.

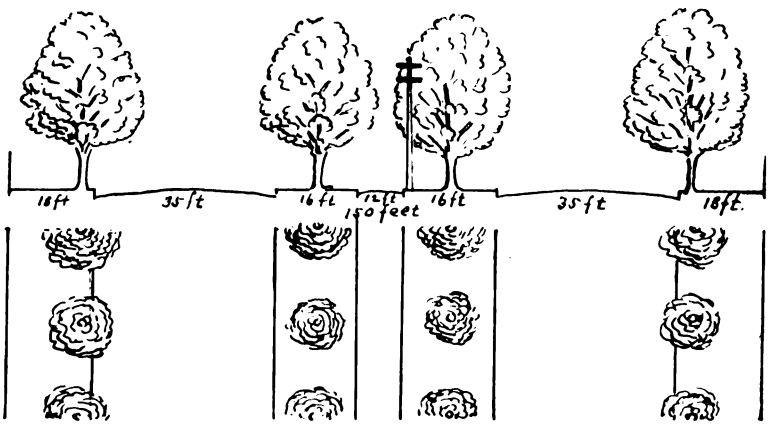


FIG. 17.

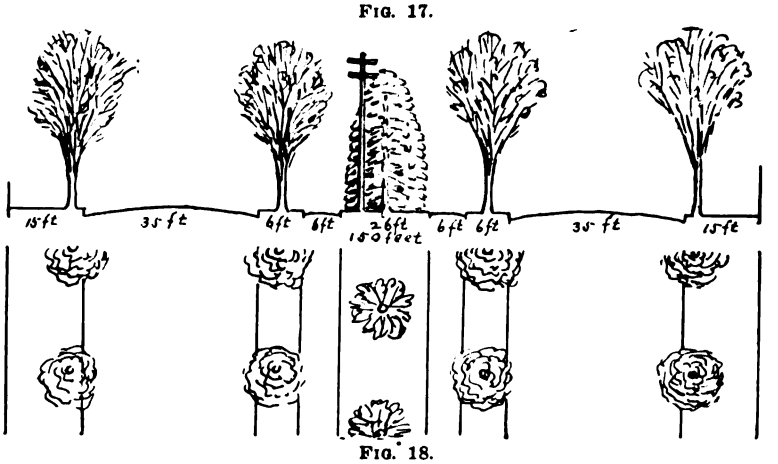


FIG. 18.

FIG. 16.—Street 125 feet wide. Two lateral rows of trees arranged alternately, one row of standard shade trees, the other of ornamental trees.

FIG. 17.—Street 150 feet wide. One lateral row on each side and two middle rows, (Arrangement of Green street, Augusta Ga. See Pl. I.)

FIG. 18.—Street 150 feet wide. One lateral row of standard shade trees on each side: three middle rows, the outer rows standard shade trees, the middle row ornamental trees.

sary that the one species should extend the entire length of the street, it should be used at least for several blocks, and on short streets with wide vistas it is preferable that the same species should exist throughout. But while the association in alternate planting of two standard shade trees on a street is not deemed advisable and is seldom attempted, in the milder portions of this State, where there is such a large number of the choicest species from which to make selection, many of them highly ornamental either on account of flowers, bark or autumn foliage, two species can be planted together and alternated with the greatest success. This has been done on a small portion of Taylor Street in Columbia, S. C., and the results are in every way artistic and satisfactory. There should be a strong contrast between the species either in size, color of foliage or form and habit. Preferably one should be a standard shade tree and the alternating species selected for some special quality, ornamental foliage or flowers.

Several combinations are suggested below in which there is contrast in the color of the foliage of the two species and difference in their habit and size.

COMBINATION OF AN ORNAMENTAL SPECIES WITH A STANDARD SHADE TREE.

Standard Shade Tree.		Ornamental Tree.	
Common name.	Botanical name.	Common name.	Botanical name.
Southern maple	*Acer floridanum*	Crape myrtle	*Lagerstroemia indica*
White linden	*Tilia heterophylla*	Locust	*Robinia pseudacacia*
Tilia argentea	*Tilia argentea*	Hardy catalpa	*Catalpa speciosa*
Water oak	*Quercus nigra*	Paulonia	*Paulonia imperialis*
Willow oak	*Quercus phellos*	Yellowwood	*Cladrastis lutea*
Sycamore	*Platanus*	Mimosa tree	*Albizzia julibrissin*
		Mountain ash	*Pyrus americana*

A small evergreen can be used as one of the species in place of the ornamental tree. This makes a combination desirable in those cities and towns which cater to winter tourists. Except the laurel oak and live oak there are no large evergreen or semi-evergreen street shade trees. There are, however, several smaller evergreen trees too diminutive to be serviceable alone during the summer season, but which could appropriately be used in connection with a larger deciduous tree. In spite of their

small size, the presence of these evergreens gives vivacity and color to what would otherwise be a gray-toned winter vista.

COMBINATION OF A SMALL EVERGREEN SPECIES WITH A STANDARD SHADE TREE.

Standard Shade Tree.		Evergreen.	
Common name.	Botanical name.	Common name.	Botanical name.
Southern maple	*Acer floridanum*	Evergreen cherry or mockorange	*Prunus caroliniana*
Cork elm	*Ulmus alata*	Evergreen magnolia	*Magnolia foetida*
Willow oak	*Quercus phellos*	Holly	*Ilex opaca*
European silver linden	*Tilia argentea*		

Trees which are eccentric either in form, as the weeping willow and weeping birch, or in color, as the purple beech, should not be extensively used for street planting. These trees have a place of their own, as on the lawn and park, but they are usually out of place on the streets of a town. Flowering species or those with bright colored autumnal foliage are not open to objection since their prevailing color is green and the season of their bright color is of short duration. Even rigid and formal shapes, which have ceased to be regarded as oddities on account of their common use, as the bolle and lombardy poplars, umbrella tree and bunge catalpa, should be used with discreet moderation. But even such extreme shapes can at times be employed to great advantage. The lombardy or bolle poplars, used before a long row of flat-roofed buildings, as a factory front, are in good taste (Pl. X).

Lastly, it might be advisable for towns to select and use one standard shade tree, which can be secured cheaply and which experience has shown to be healthy and well adapted to the local conditions, to such an extent that it will be characteristic of the town and associated with it, as are the willow oaks of Charlotte, the elms of Winston, the laurel oaks of Wilmington and live oaks of Southport. It is not meant by this, however, that they should be used exclusively, for a sufficient number of species should always be employed to give some variety to the planting.

TREE PLANTING ALONG ROADS.

It is not advisable to plant heavy foliaged trees near roads unless the roads are either macadam or are sandy. In either of these cases the

trees are a considerable protection to the road, maintaining the moisture in them which hardens either sandy or crushed stone roads, both by shading the roads from the sun and by preventing their drying by winds.

Trees should be selected for roadside planting which will interefere in the least possible way with the cultivation or productiveness of adjoining fields, and also which will yield either some valuable wood, nut or fruit.

For the middle and eastern parts of this State there is no tree superior to the pecan for such planting. Its root system is rather deep, which is an advantage in cultivating adjoining fields. When the pecan is grafted on hickory stock, as can be readily done, it should be on either the white hickory or the shagbark, since these species on account of their very deeply seated tap root and lateral roots, injure adjacent tillable land very slightly. The most important varieties of pecan are the Stuart, Bolton, Van Dewan, and Frocher. These varieties can only be propagated by grafting or by buying grafted stock which can be secured from reliable southern nurserymen. Seedling pecans are readily raised, but even when grown from the largest and finest nuts, will often yield only those of indifferent quality. Pecans for roadside planting should be spaced not less than 40 feet.

For planting in the western portion of this State the native chestnut is unequalled. While its nut is smaller than the Japanese nut, it is far superior to it in flavor, and is the equal of the Italian or Spanish nut, which is somewhat larger than the nut of the native tree. Those who desire can readily graft the Japanese stock on roots of the native species, and if it is desired to grow the Japanese nut, this would be advisable for roadside planting, since on its own roots the Japanese chestnut makes a much smaller tree than when grafted on our native species. On account of its size, however, health and the abundance of its nuts, the native species is to be recommended. It should be spaced 50 feet.

There are three native hickories which would make desirable roadside trees. These are the shagbark, Carolina shagbark and the scaly bark or red heart. Not only is the quality of their nuts excellent, but their timber is of superior quality and they attain a large size.

Cherry trees have been extensively planted on the streets of Jefferson, where they seem to have proved very satisfactory, and while such a fruit tree cannot well be recommended for towns, it would make a very desirable roadside tree in localities west of Greensboro, where the cherry thrives. Most of the standard cherry trees attain a large size and remain in healthy condition for a great many years. They should be spaced not less than 40 feet.

WALNUTS (*Juglans*).—In addition to the native black walnut, which is a very desirable roadside tree, there are several foreign walnuts which yield nuts of a better quality.

BLACK WALNUT (*Juglans nigra*) can be planted along the roads in any portion of the State. It is advisable to plant the trees in the places where they are to remain, since it does not bear removing at all well on account of its deeply seated tap root. Very large and thin-shelled nuts should be selected, as the nut of the black walnut is capable of considerable improvement. Walnut trees should be spaced 45 feet.

ENGLISH WALNUT is not hardy further west than Salisbury. In the eastern part of this State, it makes a medium sized tree and should be very generally planted, even if only seedlings are raised. These latter are inferior in the quality of their nuts to grafted stock secured from nurserymen.

Two hardy Japanese walnuts are being offered by southern nurserymen which are superior in the quality of their nuts to our native species, although much inferior to the English walnut. One of these is the *Juglans cordiformis,* whose nut bears much resemblance to the butternut. It is thin shelled and the kernel can be removed entire. It makes a large tree, forming a tap root and is hardy in the eastern two-thirds of this State. The other, *Juglans sieboldiana,* which is a native of the mountains of Japan, and which will probably be hardy in the mountains of this State, is a smaller tree with a root system of many deep-seated roots and fibrous rootlets. The nuts, which are borne at an early age in large clusters, are of superior quality, about the size of those of the black walnut but with much thinner shells. The nuts of both species can be secured at reasonable prices. For trees suitable for very dry or wet places see p. 72.

ARBOR DAY.

It is not inappropriate to refer to the observance of Arbor Day by schools and its true field of usefulness in this State.

While the same sentiment which is attached to the observance of Arbor Day in the scantily forested western states cannot be applied in a well wooded State like North Carolina, yet the observance here of such a day has its significance. Arbor Day in North Carolina could be set aside for the school children to learn of the great natural gift which we have in the forests, and the relation of the forest to the well-being and wealth of our people.

The right way to plant a tree, the treatment of the roots and crown, the manner of pressing the earth firmly about the roots, and how to prune the

branches will make good manual exercises for the school children, but it would also be well for everyone to be able to perform them.

The life of the tree is closely associated with the smallest roots which absorb moisture and the need for preserving these when transplanting should be emphasized. The moisture the tree must have, its use of manure (leaf-mould and humus), how it grows and bears its fruit are elementary to the fundamental truths of the relation of the forest to the happiness and progress of our people.

Next to the very soil itself, which in North Carolina was originally nearly all forest covered, the forest has been the chief source of livelihood for our people. If it at one time temporarily barred the progress of the farm, it yielded at the same time a revenue in furnishing both warmth and shelter. When the farming land became worn and thin or gullied, the thickets of pine again covered the soil, restoring its fertility and making it productive. The relation of the forest to the farm is paramount. It is so intimate as to be almost inseparable. On the farm the uses of wood are manifold, for fuel, fencing, building tools and barrels and crates for shipping.

Within itself, moreover, the forest sustains a vast industry, employing more than 20,000 of our men in handling and sawing and reconverting its lumber and other products.

But even this is not the limit of the direct usefulness of the forest. The value of the many rivers of North Carolina for manufacturing depends largely upon the uniformity of their flow, upon the absence of great floods, and the shortness of the period of low water, and upon how small a quantity of sand and earth is washed from the soil of our hills and mountains. Great unevenness in the flow of the streams makes it difficult to use the power. Large amounts of earth in the water fill up the ponds and reservoirs and prevent the water being stored. The forest is very important in adding to the usefulness of the rivers. The more forest there is on the streams and the thicker the sponge of leaves and litter on the ground beneath the trees the more uniform is the stream flow and the freer the water from sand and earth. And this is true not only of the big rivers but the small streams as well. The bottoms along many of them, at one time cultivated in corn, are now covered with sand bars or have been washed into deep gullies by the floods as the influence of the forest has been lessened by burning and destroying its humus in addition to clearing the land.

It is from these thoughts that the real lesson of Arbor Day can be drawn. The forest is one of our greatest and most valuable natural gifts and one which, when destroyed, lessens our prosperity, reduces our sources

of wealth, and brings great damage to other industries. As such a resource, it should be wisely used and in such a way that young trees may always come up in the forest land to take the place of those that are cut. It is important to the owner that every acre of his land should be producing something of value, and since in many parts of the State we cannot grow grass on land which has become washed or worn, or which is very steep, such land should be planted in trees that it may be growing something of use and value, for idle lands like idle hands are a reproach to both owner and State. And since the forest is one of the primary sources of wealth like our water-powers and our fisheries, the State should seek by wise laws to perpetuate them, and we should try to retain their ownership and use so far as possible among the people who live in the State, and have their homes here, in order that the wealth that the forests create as they rise in value, may remain at home. We should look forward with the hope that eventually the greater portion of our hardwoods will be manufactured into finished products within the State, keeping skilled men busy, and building cities where only towns stand to-day; and that the wood will not go out as mere rough lumber to supply the factories of other States.

These are all profitable suggestions for Arbor Day, and will serve to show what the true significance of the day should be—the relation of our forests to our wealth and prosperity.

DESCRIPTION OF TREES SUITABLE FOR PLANTING.

HARDY CATALPA (*Catalpa speciosa*), a native of the Mississippi Valley, is now naturalized around most of the larger towns of this State.

A small or middle-sized tree seldom attaining a greater height than 40 feet, it makes rapid growth in youth, passing its prime before thirty years old. The short, stout trunk covered with scaly gray-brown bark, excurrent in young specimens, but deliquescent in old, divides into a few stout spreading branches which form in old trees a broadly oval, usually unsymmetrical crown.

The catalpa has large, ovate-cordate leaves which cast a dense shade; they appear late in spring but are early deciduous. The large pale blue-purple flowers which appear in early summer are very ornamental. The twigs are stout and slightly curved and the numerous, long slender pods are pendant from them during winter until the succeeding spring.

The shallow root system develops rapidly and large specimens are easily transplanted. The crown, even in old trees, will endure vigorous pruning. The wood is rather brittle and easily broken by the wind and the crown is apt to become ragged in old age. Its rapid growth, ease of rooting, tolerance of the knife and pleasing winter appearance commends it for road-

side planting. The leaves are frequently eaten by a caterpillar, which makes it objectionable for a street tree. It is exacting as to soil, requiring a good loam or clay. Reproduction is easily procured by seed and there are no difficulties in propagating nursery stock. Two-year-old seedlings should be cut back to the root to secure a straight unforked stem. In planting along highways, the trees should be spaced 20 feet. It can readily be distinguished from the common catalpa, which is more common but is of far less value, by its shorter and more slender pods, seldom one-fourth inch thick.

UMBRELLA CATALPA (*Catalpa bungei, var. nana*) is a smaller tree than the preceding but with similar foliage and twigs, but neither flowers nor fruits. It forms a broad umbrella-shaped crown. When planted in rows it should not be spaced more than 15 feet. Stock can be secured from nurserymen. It is propagated only by grafting.

PAULONIA (*Paulonia imperialis*), a native of Japan, is now naturalized in many portions of the State. It is a middle-sized tree seldom attaining a greater height than 35 feet. Very rapid growth is made in youth, and since it is a short-lived tree, it reaches its best development before its twentieth year. The stout trunk covered with dark gray-brown, slightly rough bark divides at a low height into a few large spreading or almost horizontal branches, which form a broad flattened crown.

The paulonia has very large, thick, orbicular-cordate leaves which form a dense foliage; they appear late in spring, many usually dropping during the summer, and are early deciduous. The very large clusters of pale purple flowers which appear before and with the leaves in mid-April are extremely fragrant. The twigs are stout, slightly up-curved at the tips and bear during the winter the large erect panicles of velvety brown flower buds as well as the clusters of fruit capsules (Pl. VII, A).

The root system is shallow and develops rapidly and easily in transplanted trees, assuring the successful moving of even large specimens. The crown will endure vigorous pruning. The wood is extremely brittle and limbs are easily broken in storms. It decays rapidly, necessitating considerable care to maintain the crown and trunk in healthy condition during old age. It is not exacting as to soil and makes rapid and healthy growth under adverse conditions, if abundantly supplied with light. Reproduction is easily secured from seed as well as by root shoots, which are borne in abundance. Two-year old seedlings of nursery stock should be cut back to the ground to facilitate the formation of clear straight stems, which will be sufficiently tall and stout for transplanting by the third year. Trees should be spaced 25 feet.

ASHES (*Fraxinus*).—There are many species of this genus which are suitable for planting. Of the six native species, however, only four are to be particularly recommended: Green ash, deep swamp ash, white and Biltmore ashes.

GREEN ASH (*Fraxinus lanceolata*) is found along streams throughout the State, except possibly in the high mountains. In cultivation it is a middle-sized tree, seldom more than 50 feet high, making rapid growth in youth, reaching its best development about its thirtieth year and remaining for many years in excellent condition. The slender trunk covered with regularly furrowed gray-brown bark divides into many spreading and ascending straight branches which form a globose crown.

The green ash has opposite bright green compound leaves formed of numerous small leaflets which cast a rather light shade, often turning a dull brown in autumn. They appear late in spring and are rather early deciduous. The flowers are inconspicuous, but the drooping clusters of fruit add much life to the foliage during summer and autumn. The twigs are stout, straight and, like the branches, often forked. The root system consists of numerous rather deeply seated roots. The trees are easily transplanted. The crown will endure only moderate pruning and the leader in young trees should not be cut until the stem has made the desired height. The stem of the ash is prone to fork and this should be guarded against, for although the wood is elastic and not easily broken by storms, forking stems will frequently split. Wounds do not heal rapidly and scars on old trees which show any heart wood must be kept well painted to prevent decay. With this exception, the trees are quite free from diseases and insects. For its best development, green ash requires a good soil not too hard and dry. Reproduction is easily effected by seed which are borne in abundance. Trees should be spaced 30 feet.

SWAMP ASH (*Fraxinus profunda*) is found along the larger streams south of Morganton and east of Salisbury. It is a large tree making rapid growth in youth and reaching its best development about its thirtieth year, and remaining for many years in good health. The rather stout trunk, which is covered with very deeply and regularly chiseled brown-gray bark, divides into rather few spreading and ascending straight, frequently forked branches, which form a large globose or spreading crown.

The swamp ash has compound foliage much like that of the green ash but larger, more leathery, drooping and decidedly whitened beneath. The flowers, fruit, twigs and root system are also quite similar to those of the green ash. Although a swamp tree, it makes rapid growth in cultivation as a shade tree on uplands and is the ash most frequently planted in the

towns east of Morganton, and south of Raleigh it does much better than any other tree of this genus. Trees should be spaced 35 feet.

WHITE ASH AND BILTMORE ASH (*Fraxinus americana and Fraxinus biltmoreana*).—These trees are much alike in their foliage and habit; both are found along streams throughout the western portion of the State, extending to considerable elevations on moist mountain slopes. They have habits and cultural characters similar to those of the green and the swamp ashes, but are better adapted for planting in the extreme western portion of the State than either of the latter species. The white ash does not make as vigorous and healthy growth east of the Blue Ridge as the green and swamp ashes and is not so suitable for planting there. They should be spaced 30 feet.

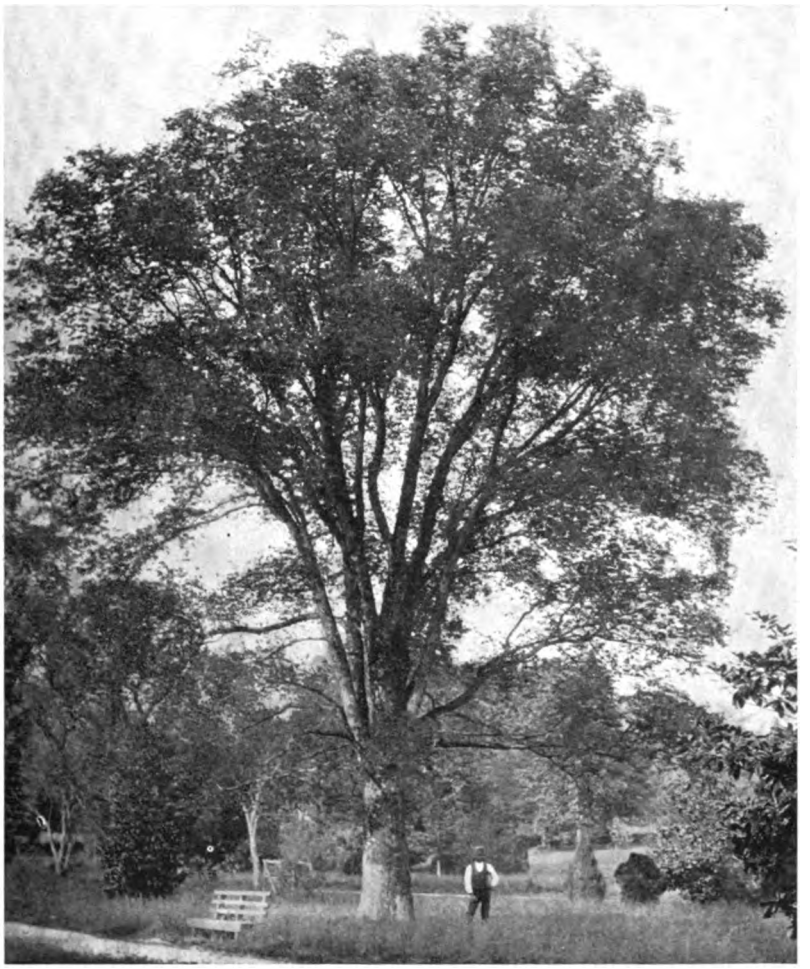
SMALL-LEAVED or CORK ELM (*Ulmus alata*) is found indigenous below an elevation of 2000 feet. A large tree attaining a height of 40 to 60 feet, it makes on moist sandy soils rapid growth in youth, and on dryer and stiffer soils rather slow but well sustained growth for a great many years, reaching its prime after the fortieth year and attaining under good conditions an age of 100 years. The slender trunk, only slightly buttressed at base, and covered with very dark gray, often nearly black rough and slightly scaly bark, divides at a low height into numerous, graceful, ascending branches, which form an elongated, vase-shaped crown. The small dark-green leaves are distichously arranged along the delicate pendulous twigs. They appear late in spring and after turning a dull yellow in early autumn, drop gradually until frost. The minute brownish-purple flowers appear in February in small numerous clusters along the twigs, and are succeeded by an abundance of silvery-brown, scale-like fruit which matures and falls the middle of April just before or as the leaves appear. The twigs are slender, dark-brown and often wing-margined on young trees and form graceful, flattened, pendulous sprays. The root system is shallow, only a moderate tap root being developed; while the lateral roots lie near or on the surface and extend great distances from the tree. The crown of young trees will endure vigorous pruning; old trees, however, recover slowly. While the wood is extremely tough, the forked branches which are numerous are easily split either in wind storms or beneath the weight of sleet (Pl. III). For this reason the tree requires careful training in youth to secure a crown free from large forks and formed of numerous well-spaced and equal-sized branches (Pls. I and VI). The heartwood, unless carefully painted after pruning, decays rapidly, but with care trees can be maintained in excellent condition until very old. It is not exacting as to soil and while the growth under unfavorable conditions is slow, the general health remains good. Reproduction is easily secured

from the seed which are borne in abundance. Trees should be spaced 40 feet. On account of its late leafing, its broom-shaped crown and its adaptability to inferior soils, this elm is especially suitable for planting unpaved streets and roads; and on account of its high arched crown, it interferes in town less with illumination than any other large tree. Its superficial roots, however, make it less desirable on paved streets, especially beneath granolithic pavements, which it at times upheaves. Beautiful in summer when its waving fronds are stirred by a breeze, it is equally so when the delicate tracery of its numerous curved branches and sweeping hanging twigs are etched against a winter sky.

WHITE ELM (*Ulmus americana*) is quite similar to the cork elm in both growth and habit. It makes, however, a small tree on upland soils, is not so long-lived, is less healthy and is more subject to internal decay. The stem is more tapering and prominently buttressed at the fluted base. The crown is broader, more spreading, and the twigs while reflexed do not form the graceful, drooping sprays which characterize the preceding species. The leaves, appearing two weeks earlier than those of the cork elm, are larger, of a brighter green, and the fruit, appearing in March and maturing before the leaves are full grown, is green instead of brown. Except the scant verdure of its early fruit, which is the first welcome green of the trees, the white elm, in this State, does not make as acceptable a shade tree as the other native elms. Nevertheless, it is extensively planted in many of the towns east of the Blue Ridge, and is not in fact usually separated from the cork elm. The white elm has been attacked at Winston (where it has been extensively planted) and at other points north and west of Greensboro, by the imported elm leaf beetle, an insect which, when locally well established, largely destroys the foliage of the elms. It is hoped that climatic conditions will prevent its spread south and east of Greensboro.

SLIPPERY ELM (*Ulmus pubescens*) has a more spreading fan-shaped crown than the small-leaved elm and larger twigs and foliage. It is less common than the small-leaved and is in no respect superior to it as a shade tree. It grows, however, throughout the high mountain counties and is available for planting in that section, as well as in other portions of the State.

HACKBERRY (*Celtis Mississippiensis*), a native tree, is found along the larger water courses. In the coastal plain it acquires large proportions, but westward is smaller. Its growth is rapid in old age as well as in youth, reaching maturity as a shade tree by its twenty-fifth year. The short stout trunk is covered with smooth, light-gray bark, and often roughened with large, cork-like excrescences. The fluted base is enlarged



TYPICAL ELM, VASE-SHAPED CROWN, FORMED OF MANY ASCENDING STEMS.

and the trunk divides at a low height into many wide-spreading, angular branches and slender, intricate branchlets, which form a large globose or flattened crown. The foliage is small and elm-like and appears delicate green in early spring, maturing by mid-April before that of other species have scarce burst their buds. The root system is like that of the elms, superficial and spreading. Few trees, however, replace roots more rapidly, which enables large specimens to be planted with perfect success. The crowns, even of old trees, endure the most vigorous pruning, but the wood decays with such rapidity that every precaution is necessary to prevent hollows and defective trunks. The wood is brittle and easily broken by sleet and wind storms. Not exacting as to soil, the hackberry makes satisfactory growth, except on dry, heavy clays. Young plants are easily secured from seed which are borne solitary in a small cherry-like berry that matures in the late fall and remains on the tree throughout the winter. It should be spaced 40 feet. Except in its very early leafing and smooth white bark, the hackberry possesses no characters which give it preference above the small-leaved elm. It is planted almost to the exclusion of other species on the streets of Columbia, S. C.

HICKORIES (*Hicoria*).—Of the many species of the genus which are native to the State, only three deserve consideration for general shade planting in parks or on roadsides. These are the shagbark, the Carolina shagbark and the red heart or scaly bark.

SHAGBARK (*Hicoria ovata*) is one of the most widely distributed trees of the State, occurring along streams and on moist slopes from the coast to an elevation of 3000 feet. As a shade tree, it attains a height of from 60 to 70 feet, making rapid growth in youth and maintaining a healthy condition to an advanced age. The straight cylindrous trunk, covered with long narrow strips of loose gray bark, is excurrent until the tree is well past its youth. The crown of the young tree is pyramidal but becomes broader and more oval as the trunk branches with age. The compound leaves are formed of large drooping leaflets. They are bright green and fragrant when they appear in early spring; afford a dense shade during the summer and turn various tones of yellow and brown in late autumn before falling. While the flowers are not conspicuous, the scales of the winter buds greatly enlarge in unfolding in the spring and assume many delicate shades of red and yellow. The twigs are stout, usually slightly curved and tipped with large acute buds which are conspicuous during the winter. The fruit from which the thick husk freely splits is white, thin-shelled and the most delicately flavored of any native nut. Nuts are usually borne in abundance in this as well as in the other species.

A very large tap-root is rapidly developed in youth which greatly interferes with transplanting even small specimens. Hickories admit of moderately severe pruning, especially in youth. The wood is tough and is not liable to injury by wind storms, but top branches are occasionally badly broken by sleet. A twig girdler does much damage by pruning small branchlets and in many localities a timber beetle is very destructive to middle-aged and old trees by girdling them beneath the bark. The foliage is remarkably free from fungus diseases; the wood, however, rapidly decays if wounds are left unprotected. It is not over exacting as to soil and will produce a nice, shapely tree on soils of moderate fertility, if once successfully started. Nuts, which are easily procured, sprout readily; but it is better to plant them in the place where the tree is to grow either in parks, private grounds, or along roadsides, than to transplant young trees. Trees should be spaced 40 feet.

CAROLINA SHAGBARK (*Hicoria carolinæ septentrionalis*) is a native tree growing on uplands, usually on sandy soils from Wake to Guilford counties across the State from Virginia to South Carolina. It is similar to the shagbark but a smaller tree with a slightly smaller nut and smaller twig and foliage. On thin dry soils it makes more satisfactory growth than the common shagbark. Nuts are usually borne in abundance and can be secured for planting from nearly any county between Person and Anson.

SCALY BARK or RED HEART HICKORY (*Hicoria odorata*) is found throughout the State, preferring fertile upland soils. It is a large tree attaining in cultivation a height of from 50 to 70 feet, making moderate growth until an old tree and reaching an age of more than 100 years. The straight, cylindrical trunk is covered with dark gray scaly-brown bark or occasionally merely deeply and irregularly furrowed. In young trees the trunk is excurrent and the crown conical or ovoid, but in old trees it is much divided near the top and the crown assumes a broader and rounder shape. The red heart hickory has dark green compound leaves formed of large drooping leaflets, the petioles often tinged with red or purple. They are fragrant in spring when they appear and turn lemon yellow before falling in autumn. The lustrous purple-brown twigs are slightly curved and spreading.

A deep tap-root is developed interfering with successful transplanting. In its ability to endure pruning and its behavior in wind and sleet storms, it is quite similar to the shagbark. Not so exacting as to soil, it makes more satisfactory growth on close upland soils than the preceding species. It is propagated in the same way. Trees should be spaced 40 feet.

PECAN, a native of the lower Mississippi valley and Gulf States, has been extensively planted throughout eastern and middle Carolina. A large tree, attaining a height of from 50 to 70 feet, it makes rapid growth in youth and possesses a prolonged and healthy old age. The long, slender trunk, covered with more or less scaly dark gray bark, divides when middle-aged into many spreading and ascending branches forming a broadly oval crown.

The pecan has large dark green, compound leaves formed of numerous small leaflets, which appear late in spring and fall late in autumn, acquiring tones of yellow and brown. The greenish-yellow flowers which appear considerably before the leaves in slender catkins are not very conspicuous. The slender, slightly curved gray-brown twigs are flexuous and bear long but inconspicuous gray buds, and often during winter the empty husk which contained the nut.

A tap-root and numerous long surface roots are developed. In subjects raised in the nursery the tap-root must either be turned by placing a hard substance beneath the nuts, or cut several times in re-transplanting. The leader should not be cut back further than the twig of the year if young trees are expected to form a shapely crown. The crown of young trees is oval, becoming broader with age. The wood is not quite so tough as that of the shagbark, but it withstands both sleet and wind storms very well. For its best development, it is exacting as to soil, requiring a fertile, moist situation; but does moderately well on uplands of good quality. Nuts are borne in abundance on seedlings after the fifteenth year, but several years earlier on grafted stock. Young trees are easily raised from seed which require the same care and are subject to the same diseases as the other hickories. Trees grown from seed cannot be expected to always produce nuts equal to those that were planted, since most of the commercial nuts are from grafted stock. Grafted trees can be secured from commercial nurserymen. There is no nut tree more suitable for extensive planting in the middle and eastern part of Carolina than the pecan. It will do well in nearly all portions of the State except the mountains, for either roadside planting, large parks or private grounds. For planting above an elevation of 1200 feet, both seed and grafted stock should be secured only from Mississippi River points north of St. Louis, to insure hardiness.

BLACK WALNUT (*Juglans nigra*) is found growing throughout the State. A large tree attaining as a shade tree a height of 50 to 70 feet, it makes rapid growth for several decades, maintaining a long and healthy old age. The straight cylindrical trunk, covered with nearly black, deeply furrowed bark, is excurrent in young trees which have a conical crown but at middle age divides and the crown becomes broadly oval.

The large bright green compound leaves are formed of numerous leaflets. They appear late in spring, form a dense shade during summer and turn dull brown before falling late in autumn. The flowers are not conspicuous. Twigs are stout and spreading. The root system has a deep tap-root which hinders the transplanting of any but the smallest specimens. Young trees can be moderately pruned but old trees not so severely. The wood is elastic and well withstands storms. The walnut does very well on upland soils if not too dry and sandy, although it naturally grows only in moist fertile situations. A high percentage of the nuts germinate and young trees are easily raised, but since transplanting is rendered difficult on account of the tap-root, they are best planted in the place they are to grow. Trees should be spaced 40 to 50 feet.

TULIP or YELLOW POPLAR (*Liriodendron tulipifera*) is a native tree found in moist, cool situations throughout the State, most abundant in the western portion of the State and least so in the coastal plain region.

In cultivation it becomes a large-sized tree attaining a height of 70 to 80 feet and an age of more than 100 years. The excurrent trunk, covered with light gray regularly furrowed bark is straight and cylindrical, only slightly tapering. The crown, conical when young and oval when mature, is formed of many short slightly ascending, gracefully arched branches. The bright green lustrous foliage appears very early in spring, forms a moderately dense canopy and turns a bright yellow in early autumn before falling. The ornamental yellow and orange flowers appear in April and May when the foliage is nearly grown. The twigs are long, curved and tipped with large conspicuously flattened buds (Pl. II, A).

On account of its excurrent stem the tulip poplar will not endure top pruning and must be given abundant room for the perfect development of its splendid crown. The leader should not be cut back beyond the wood of the season. Severe pruning in any portion of the tree tends to produce short branches or false leaders, which greatly mar the beauty and symmetry of the crown. Care must be taken to remove any false leader, which naturally develops, as early as possible. The tree is remarkably free from the attacks of both fungus and insect diseases, but suffers from sun scald when young.

The root system is rather deeply seated and formed of large, fleshy roots, and transplanting should take place late in spring just before the foliage begins to develop. While seed are borne in abundance only a few are fertile, but young plants are easily raised if lightly shaded until two years old. Trees should be spaced 40 feet. While not suited for general street planting, there is no finer tree for avenues in places west of Statesville.

CUCUMBER TREE (*Magnolia acuminata*) is indigenous to the mountains of this State, but grows well in cultivation from Raleigh westward. It forms a slender tree of moderate size, becoming upward of 60 feet in height. The excurrent trunk is covered with light-gray, slightly scaly bark; and the long symmetrical crown, conical when young, and oval when past middle age, is formed of numerous short nearly horizontal or slightly ascending angled branches, with ascending tips set with short, stout, spur-like, erect twigs. The bright green lustrous foliage appears early in spring and forms a dense shade. The greenish white fragrant flowers open in May soon after the leaves and are succeeded by the conspicuous green or reddish fruit. The large, silvery-gray velvety buds are prominent in winter. Like the tulip poplar, the cucumber tree cannot be severely pruned. It also requires the same care in transplanting. It is not known to be subject to any diseases.

The fleshy seed should be collected from the cones in September and kept like those of the other magnolias during winter. The seedlings require a slight shade during the first two years. While scarcely adapted for ordinary street planting, the cucumber tree lends itself admirably on account of its dignity, straight trunk, symmetrical crown, lustrous foliage, and pleasing winter appearance to planting avenues and parks. A handsome specimen, more than 75 feet in height, ornaments the State House grounds at Raleigh.

MOUNTAIN MAGNOLIA (*Magnolia fraseri*) is a native of the higher mountains of this State and so far as is known, has not been cultivated below them. There is little reason, however, why it should not do as well as the cucumber tree where that will thrive.

It is a middle-sized tree attaining a height of from 40 to 50 feet, reaching its maturity before its fiftieth year and rapidly passing into senile decrepitude. The excurrent trunk is straight and cylindrical, covered with smooth light-gray beech-like bark. The crown, formed of few spreading branches, is oval when young and broadly oval at maturity. The ample bright green, lustrous leaves are borne in spreading whorls at the tips of the twigs. The very large, creamy-white flowers, 8 inches or more in diameter, appear before the leaves at the tips of the twigs in early May and are followed in mid-summer by the beautiful scarlet fruit, 4 inches or more in length on declined or even pendant pedicles. The few very large red-brown lustrous twigs are upcurved at their tips and capped by prominent, elongated buds.

As in the case of the other magnolias, it should be pruned only in extreme moderation. It requires the same care in transplanting and is propagated in the same manner as the cucumber tree. The foliage is free

from insects and fungus diseases. The wood, however, is brittle and frequently broken in wind and sleet storms. It decays rapidly on exposure and when pruned must be carefully protected. It has a tendency to sucker around the base of the stem and such sprouts should be promptly removed. They can often be used for propagation.

While a smaller tree than the cucumber tree and lacking its symmetry and dignity, the mountain magnolia is well suited for planting avenues and for use in parks, in the western portion of the State.

EVERGREEN MAGNOLIA (*Magnolia fœtida*) is a native of the southern United States and varieties of it can be cultivated in this State, in sheltered positions, as far west as the foot of the Blue Ridge, though much of the foliage will often winter-kill west of Raleigh and Charlotte.

In cultivation it makes a middle-sized tree attaining a height of 40 feet and reaching, except in favored localities, old age by its sixtieth year. The trunk is excurrent and the smooth bark dark olivacious gray. The crown, formed of numerous horizontal branches, is conical when young and oval at maturity. While there are several horticultural varieties differing slightly in size, shape and shade of the leaves, they are in all forms large, thick, leathery and evergreen. The flowers, deeply cup-shaped, from 8 to 10 inches wide, appear in different varieties from May to July, and are followed by the oval red-berried fruit.

The magnolia can be pruned only in moderation. Care should be taken in developing young subjects to prevent the formation of forked stems. Only one leader should ever be allowed to remain, and false leaders, which occasionally occur on branches, should be promptly removed. A magnolia should always assume the shape of a pyramid, the foliage mass rising unbroken from the ground, and for this reason the lower branches should not be removed, but should be trained horizontally, and allowed to grow to their full limit and thicken as much as possible in order to fully conceal the base of the stem. The young subjects should be trained to develop numerous low branches with this object in view. The roots are few, large and fleshy, and penetrate the ground to a considerable depth, requiring for best development a light moist fertile soil. As is the case with the other species of this genus, the magnolia is not easily transplanted. The best season is late spring and then the leaves should be pulled or clipped and only small specimens used. Magnolias can be used to best advantage for street planting only in alternation with other species, and are not adapted for general street planting, but permit of occasional use on parking strips, etc. In planting along avenues and drive-ways, specimens should never be placed within 15 feet of them to allow for the future spread of the lower branches.

AMERICAN LINDEN AND WHITE LINDEN (*Tilia americana and Tilia heterophylla*).—There are several species of linden which are adapted for street planting. All have nearly similar foliage, the same general character of branching and forming the crown and attain in cultivation about the same proportions. The two native species which are available are the American and White lindens, both natives of this State and both easily secured from nurserymen. They are quite similar except in the color and size of their foliage, which in the American linden is smaller and bright-green beneath; while that of the White linden is more ample, thicker and of a silvery whiteness below.

In cultivation the native lindens attain a height of 30 to 45 feet, making rapid growth, especially in youth, which is well maintained to a considerable age. They are rather exacting as to soil and do best on loose moist loams abundantly supplied with organic matter and furnishing copious root space. The trunk, covered with thin, light gray, slightly furrowed bark, divides at a low height into many erect and ascending branches, forming an oval or in old age a broadly oval crown. The leaves, differing slightly in the two species, appear late in spring, form a dense canopy, and turning dull yellow or brown, fall early in autumn. The large, pendulous clusters of fragrant flowers, appear late in May or early June and are succeeded by the dry berry-like fruit appended to narrow leaf-like bracts which often remain on the twigs until late in winter. The branchlets divide into many stout, gracefully curved twigs.

The lindens endure pruning extremely well and over large crowns can be heavily topped. While the wood is soft, it is elastic and not badly broken by storms. It decays easily and wounds must be promptly protected. Forest pulled specimens sun scald.

The root system is shallow but finely divided. Broken roots are freely replaced and transplanting of even large trees is successfully accomplished. Young plants can be abundantly secured from seed but must be protected by lattice-shade until two years old. On account of the rapidity of their growth, the ease with which they recuperate from heavy pruning and with which they can be transplanted, their freedom from disease, dense foliage and symmetrical crown, the lindens are among the most desirable shade trees. Trees should be spaced 40 feet.

The EUROPEAN SILVER LINDEN (*Tilia argentea*), a tree of the old world carried in stock by most nurserymen, has the same general characters as the native species, but is more desirable in several particulars. The ramification of the twigs is more numerous and the twigs themselves are more slender, flexuous and delicate. The crown is more compact and the twigs spread horizontally from the ascending branches which gives a

charming winter effect. The leaves, small and silvery-white beneath, form a dense canopy. In this State it apparently is better adapted to both poor and heavy soils than the native species. Its tendency however is to form a short trunk and this must be rectified by judicious trimming. (*Tilia europea, T. parvifolia,* etc., should not be planted.) Trees should be spaced 30 feet.

HORSE CHESTNUT (*Aesculus octandra*), a native of Asia Minor, is now extensively naturalized in this State. It is a middle-sized tree making rapid growth until well advanced in age. The stout trunk covered with gray-brown scaly bark is naturally excurrent in the juvenile period, but divides into many branches in middle age. The crown, oval in youth, becomes very broadly oval in old age, or when the tree is heavily topped. The dense foliage is compound and droops from the tips of the common leaf stalk. The large panicles of highly ornamental white, pink-tipped flowers are succeeded by the fruit burrs. The straight stout chestnut-brown twigs bear during the winter large oval buds. While a deep tap-root is naturally developed, the trees are easily transplanted and root readily. Few trees are more tolerant of the knife and the crowns recover vigorously after heavy pollarding. Young trees are easily raised from seed which are borne in abundance. Trees should be spaced 35 feet.

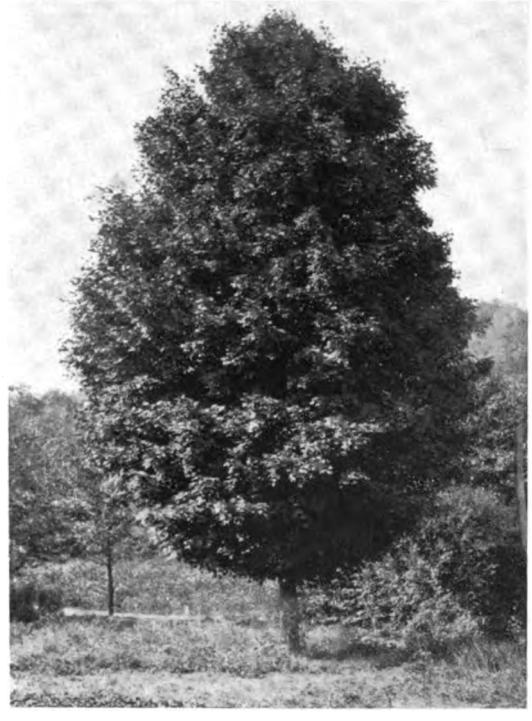
BUCKEYE (*Aesculus*), a native, middle-sized tree, is suitable for planting on fertile soil west of the Blue Ridge. It preserves the same general character as the horse chestnut, but is more exacting as to soil and the flowers are not so showy. Forms occur with pink and red as well as yellow flowers. The flowering period, which is early in May, lasts only a few days. Trees should be spaced 30 feet.

MAPLES (*Acer*).—The maples constitute the most widely planted group of shade trees in the United States, and are probably better adapted to street conditions than any other trees. There are four native species which are suitable for planting in this State.

NORWAY MAPLE (*Acer platanoides*).—Besides the native species, described below, this European tree has been planted at considerable expense around many towns. It has fastigiate branches and forms a narrow crown. Its foliage is not so dense as that of the native species, but closely resembles that of the sugar maple, from which, locally, it is not separated. It lacks the autumnal brilliancy of the native trees and is not superior to well-grown stock of the native hard maples.

SOUTHERN MAPLE or SOUTHERN SUGAR MAPLE, grows in this State along streams east of Salisbury. It is a middle-sized tree, seldom attaining a height of more than 40 feet, making rapid growth in youth which is fairly well maintained until past middle age, but the growth in old age

A. PAULONIA, SIX YEARS OLD, 20 FEET HIGH. GLOBOSE CROWN. A VERY RAPIDLY GROWING TREE WITH DENSE FOLIAGE AND A TROPICAL APPEARANCE. BUT SINCE IT IS SHORT LIVED AND BECOMES RAGGED IN OLD AGE IT IS NOT DESIRABLE FOR GENERAL USE.



B. WELL DEVELOPED SUGAR MAPLE IN MIDDLE AGE. THIS SHAPE IS CHARACTERISTIC OF TREES WHICH HAVE NOT BEEN TOPPED.

is slow. Trees fifteen years old are already of good size. The rather stout trunks divide at a low height into many slender, ascending flexuous branches which form an oval or broadly oval crown. The twigging is abundant, fine and graceful. The drooping foliage, dark green above and white beneath, appears early in April after the delicate pendulous greenish-yellow flowers and forms a dense shade. In autumn it is conspicuous with shades of red and yellow. (See Pl. VIII.)

The fibrous, rather compact root system enables it to be easily transplanted and its adaptability to all classes of soils makes it one of the most suitable trees for general planting east of Charlotte and Winston. It stands pruning well, even in old age, but very large branches must not be cut back without leaving sap lifters; otherwise their stumps will die. While the crown is usually symmetrical, it is not so much so as that of the northern sugar maple, and single branches often make rapid and irregular growth, requiring some care and pruning to maintain in form.

It is extremely free from insects and diseases, except the susceptibility to sun-scald, necessitating the protection of the stems of young specimens, at least of forest-pulled stock. There is no more desirable tree for the planting of streets of towns and cities or of roads where quick growth, dense shade and a not over large size tree is desired than the southern maple. It is easily propagated from seed which mature in October. Trees should be spaced 40 feet.

Sugar Maple (*Acer saccharum*) is a native of the mountains of this State. It is a middle-sized tree, becoming in cultivation somewhat larger than the southern maple but with about the same rate of growth; rapid in youth and gradually declining with old age. Both this and the southern maple maintain soundness and dense symmetrical crowns until three-quarters of a century old. The crown is somewhat narrower and habit of growth more fastigiate in this than in the preceding species. The bark on the limbs and branchlets is ashy gray and lacks the pinkish tinge which is typical of the southern maple. The dense foliage is dark green on both sides and, as with the other species, acquires in autumn many brilliant shades of red and yellow. (Pl. VII, B)

It has the same root system and stands pruning equally as well as the preceding but naturally forms a more symmetrical crown. It is the most desirable tree for general planting in this State west of Salisbury and is easily raised from seed which ripen in autumn. Trees should be spaced 40 feet.

Red Maple (*Acer rubrum*) is found throughout the State either in its typical form with five-lobed, bright green leaves, or in the trident form which has smaller leaves, extremely dark green above and whitened be-

neath. It is a middle-sized tree seldom attaining in cultivation a greater height than 35 feet. The growth in youth is rapid but it falls off considerably when past middle age. As a shade tree it is not very long-lived and specimens 40 years old are usually past their prime. The rather slender trunk covered with light gray scaly bark divides into a few spreading branches which form an oval, usually unsymmetrical crown. The bright red spreading twigs are stouter, shorter and stiffer than in the hard maples and are knotted during the deciduous season by the large, globose flower buds, from which in February and March appear the small clusters of bright red or yellow flowers, followed by dense masses of fruit, at first green, and at length just as the leaves are appearing, bright scarlet.

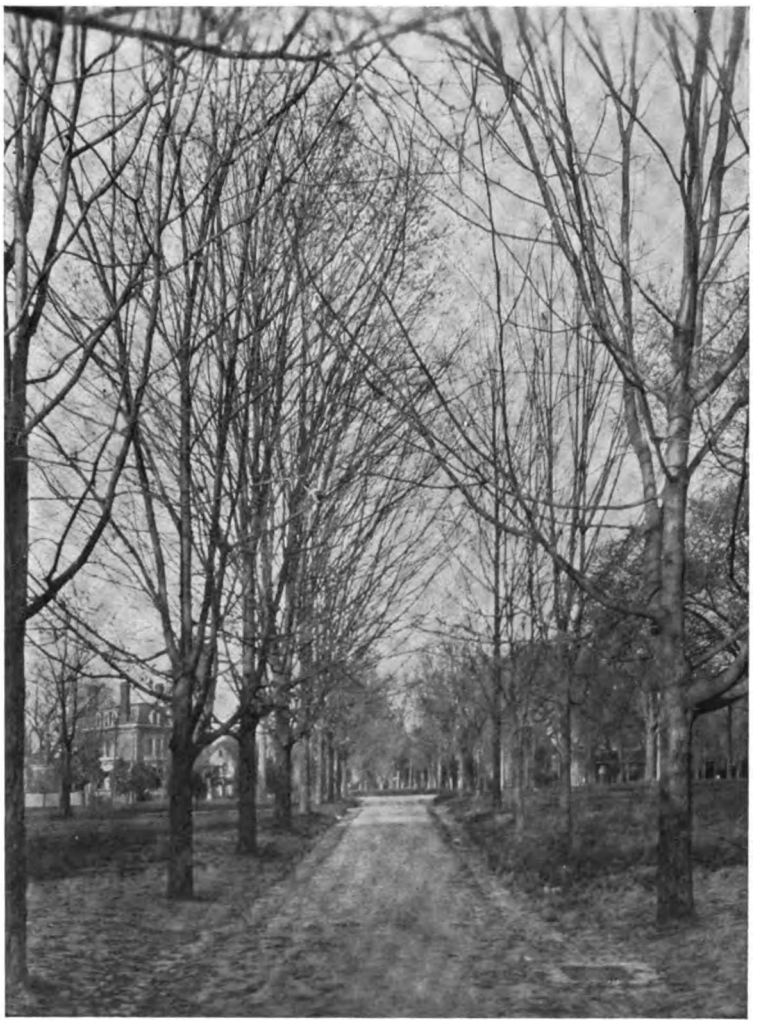
It is one of the trees most easily transplanted, but only makes satisfactory growth on soils of good quality and should not be planted on stiff, dry, or on very light, poor soils. It stands trimming well, especially when young.

The leaves are netted by leaf miners and spotted by a species of parasitic fungus. Young stems are subject to sun-scald if unprotected, and freshly exposed wood is liable to rapid decay. Seeds mature in May and should be at once planted. Trees should be spaced 30 feet.

SILVER MAPLE (*Acer saccharinum*) is a native of river swamps in the eastern portion of the State, but is extensively planted in all of the larger towns. It is a small or middle-sized tree, seldom more than 30 feet in height; short-lived, attaining its prime in 20 or 25 years, and making very rapid growth especially in youth. The slender trunk, covered with dark gray, scaly bark, divides at a low height into a few slender, ascending branches which form an irregular broadly oval or flat-topped crown. The long, rather stout and bright colored twigs are pendulous as are the branchlets. The beautiful, deeply-lobed, bright green foliage appears very early in spring, forms rather a light shade during summer, turns very brilliant in autumn and falls early.

It roots extremely easy and is one of the most readily transplanted trees. Even large specimens stand heavy pruning. The leaves are subject to few diseases, but the soft brittle wood is easily broken by sleet and wind storms and decays rapidly on exposed surfaces. It is easily propagated from seed which mature in May. Trees should be spaced 35 feet.

BOX ELDER or ASH-LEAVED MAPLE (*Acer negundo*) is a native tree which is much advertised by nurserymen. It is related in its twigging and general characters to the maples, but is much smaller than any which have been mentioned. It is too small in fact to make a desirable shade tree and its habit of low branching and forming short stems, which is not easily rectified, makes it generally undesirable.



SOUTHERN MAPLES. ASCENDING HABIT OF TREES PLANTED CLOSE TOGETHER. IN A FEW YEARS EVERY OTHER TREE SHOULD BE REMOVED TO GIVE NECESSARY GROWING SPACE AND PREVENT DEFORMITIES.

There are several species of extensively advertised foreign maples, but none have any characters which would give them preference for this State over the native species for cleanliness, health, rapidity of growth, symmetry or beauty of autumnal foliage.

DOGWOOD (*Cornus florida*), a common native tree fully as beautiful in autumn with its crimson foliage and in winter with its small clusters of scarlet fruit as in spring when covered with a profusion of large white flowers. It is too small, however, to be used as a shade tree under any circumstances, 10 to 15 feet being the usual height; but it might occasionally be alternated on broad planting strips with standard shade trees. It is not difficult to transplant but is of slow growth and the stems should be well trimmed up before it is permitted to form a crown.

BLACK GUM (*Nyssa sylvatica*) is one of our most striking native trees, with slender horizontal branches, short, spur-like twigs, and dark green clean glossy foliage which becomes crimson in early autumn. It makes a very handsome shade tree for parks or private grounds and might be occasionally tried for street planting. It is difficult to transplant, however.

SWEET GUM (*Liquidambar*), a common tree in this State east of Statesville, reaches a large size, making rapid growth, especially in youth. The stout trunk is excurrent. The crown, formed of numerous branches, is conical in young specimens and ovoid in old. The twigs are large, rather abundant and are frequently cork-winged. The foliage is dense, very deeply lobed, of a bright pleasing green color and becomes scarlet in autumn.

Some little difficulty is experienced in transplanting sweet gum on account of its deeply seated tap-root, requiring it to be moved when young and very small. If carefully moved it readily takes root and makes satisfactory growth on moist, loose soils. The leader should not be cut back beyond the wood of the season, since false leaders are readily produced in the branches, which cause misshapen crowns. Even old trees, however, stand vigorous lateral pruning. The sweet gum is free from insects and diseases but freshly exposed wood surfaces decay rapidly. On account of its narrow conical crown, handsome foliage and nice appearance in the winter, the regular ascending branches and shining twigs, often having the globose fruit cones pendant from them until the following spring, it is suitable for planting avenues or for other formal lines. It should be spaced 40 feet.

LOCUST or YELLOW LOCUST (*Robinia pseudacacia*).—This tree is found throughout the middle and western portions of the State. It is a slender tree of medium growth, attaining in favored localities a height of 50 feet

and an age of 50 or 60 years. The trunk, which is inclined to be crooked, usually passes well up in the crown before dividing. The crown is narrowly oval, becoming broader in old trees and the compound foliage is light, airy and graceful. The locust bears large drooping clusters of white fragrant flowers in early spring. It stands pruning extremely well. The root system is shallow and the tree is therefore very easily transplanted. The foliage is attacked by several insects, though rarely badly damaged; and the trunks of trees are subject to the attack of a species of polyporus which destroys the heartwood and weakens the stem. For this reason exposed wood, although the surface is very small, should be carefully painted, for since the sapwood is only a few rings thick, the heartwood will usually be exposed even when small limbs are removed. The roots are apt to produce suckers which should be promptly removed. It can be propagated either by seed or from suckers.

The locust makes a desirable tree for planting in many places in the middle and western portions of the State and, while not well adapted to prolonged lines, on account of the attention it requires, its beautiful foliage and fragrant white flowers make it occasionally desirable. There are many handsome trees in Salisbury where it was formerly more extensively used than at present. Trees should be spaced 35 feet.

RED-BUD (*Cercis canadensis*), a common native tree of small size, which has an abundance of small dark rose flowers along its thin, sinuous branches in March before the leaves appear. It is easily transplanted and stands trimming very well, which is seldom necessary, as its small, broad, flattened crown is usually well shaped and requires little attention. It is too small to be used alone as a shade tree but could serviceably be used in alternation with standard trees in parking strips.

HONEY LOCUST (*Gleditschia triacanthos*), a well known extensively naturalized tree, which forms a stout trunk and a large spreading crown of numerous tortuous branches and twigs. The thin, light green, finely divided foliage is extremely attractive. For street trees the thorny stems and large pods render it objectionable, but it is well suited for roads and parks. It is easily transplanted, having a shallow, fibrous root system, stands pruning well and is readily propagated from seed.

MIMOSA TREE (*Albizzia or Acacia*), a native of southern Asia, has been extensively naturalized in middle and eastern Carolina. It is of small size, seldom more than 25 feet in height, nor does it make an old tree. Specimens 30 years old are usually well passed their prime. The trunk is short, unless carefully lengthened and the broad flattened crown is much like that of the umbrella tree, although the branches are less nu-

merous. The foliage which appears very late in spring is finely divided and of a pleasing green color. It is sensitive, slowly folding after irritation and at night. It is covered in June and July with a profusion of very fragrant rose-colored flowers, which render it one of our most desirable ornamental trees. It stands pruning well but the wood decays rapidly on exposure. It is free from insects.

It is one of the most desirable ornamental trees which we have for parking, narrow streets, or for alternating with standard shade trees. For lawns or for small avenues it is also desirable. Its only disadvantages are the tendencies to form a low trunk and its short life, which are more than offset by its beauty. It is easily propagated from seed and is perfectly hardy as far west as Statesville. Trees should be spaced 30 feet.

KENTUCKY COFFEE TREE (*Gymnocladus dioica*) is an introduced tree occasionally planted in this State. While very striking on account of its flowers, large compound foliage, nearly ascending branches and stout twigs, its wood is brittle and easily broken by storms and its extensive planting is not recommended.

CRAPE MYRTLE (*Lagerstræmia indica*), a native of India, frequently planted throughout the coastal region of the Southern States, is a slender tree with several stems from the same root, and short, fastigiate branches, forming an oblong crown. It reaches a height of 35 to 45 feet and the cluster of stems attain a diameter of 12 to 24 inches, each stem being from 6 to 8 inches through. The smooth bark is russet or occasionally olive brown and the stems are more or less fluted. The small, thin, dark green foliage appears late in spring and turns crimson in early autumn. The flowers, of a deep rich crimson, pink or pure white, according to the horticultural variety, are borne in abundance during the summer months, the flowering period being quite extended.

The root system, while rather deeply seated, is compact and young plants can be easily transplanted. When trees become too tall or spreading, they can be either topped or trimmed. The crape myrtle is free from insects and diseases. It is easily propagated either from the seed or by shoots which appear around the base of the stem.

One of our most gorgeous trees, it is scarcely adapted for general street planting, but can advantageously be used for several blocks as an ornamental tree or for planting in parking strips or in alternation with standard shade trees, or along small avenues.

EVERGREEN CHERRY or MOCK ORANGE (*Prunus caroliniana*).—This tree is a native of the coast but is hardy in this State as far west as Raleigh and Charlotte. It is a small and short-lived evergreen tree attaining a height of 20 to 35 feet and an age of 30 to 40 years. It has a short trunk

with dark brown, cherry-like bark, which divides at a low height into many rather wide-spreading branches which form a flattened crown. The beautiful lustrous foliage is evergreen, and during early spring is rendered more attractive by a profusion of pale pink and white flowers, which have a delicate fragrance. The fruit is inconspicuous.

The root system is shallow and rather compact, enabling trees to be easily moved, but care must be taken to strip subjects of their foliage before removing. It stands pruning very well, producing numerous small branches. While free from diseases, the wood of old trees decays rapidly if exposed, and in the latitude of Raleigh and westward twigs are frequently frost killed during severe winters. The evergreen cherry, in spite of its small size, is one of the most desirable evergreen trees for street planting on account of its attractive foliage and flowers. It is especially suited for planting driveways and avenues in localities where it is desirable to use a smaller evergreen tree than the laurel oak. It can also be advantageously used in alternation with standard shade trees to obtain during the winter a bit of verdure on the streets. It is readily propagated from seed. Trees should be spaced 25 feet when planted alone.

CHINA TREE (*Melia azedarach*), an Asiatic tree extensively naturalized in this State as far west as Salisbury, is a middle-sized tree of rapid growth becoming 35 to 40 feet high and forming a broad, spreading crown. The dark green, dense, finely divided foliage is scarcely less attractive than the large panicles of extremely fragrant lilac flowers, which appear in April and early May. While it is one of the latest trees to put forth its foliage, its spring appearance as well as that during the winter is rendered pleasing by the stout open twigging and large clusters of lustrous yellow-brown berries. The wood is brittle and breaks badly during storms and wounds must be promptly protected to preclude decay. It endures heavy pruning and few trees are more easily transplanted. It is readily propagated by seed.

While undesirable for planting along walks on account of its berries, it can be advantageously used along parking strips in which there are no walks, as well as an ornamental tree in parks and on private grounds. While it has fallen into disfavor on account of its former use in ill-chosen situations, there is no more attractive tree of its kind which can be planted in the eastern two-thirds of this State.

UMBRELLA TREE (*Melia azedarach umbraculifera*) is a horticultural variety of the China tree, and is propagated by grafting. A much smaller tree than the China tree and with a shorter trunk, it forms a broad, spreading umbrella-shaped crown with dense dark green foliage. The short trunk divides into a number of even-sized, ascending branches

of the same length. It has the same aboricultural characteristics as its type, but can be propagated only by grafts. Young stock can be procured from nurserymen. A small and short-lived tree, it is well suited on account of its rapid growth, dense umbrage, unique and symmetrical crown, for small avenues and narrow streets. It should be spaced 25 feet.

YELLOWWOOD (*Cladrastis lutea*), a native of the mountains of this State, is a slender, rather short-lived tree becoming 35 or 40 years of age and reaching a height of 25 or 30 feet. It forms a broad, vase- or fan-shaped crown, with a thin canopy of light-green, compound, drooping foliage. The bark is smooth and light gray on both trunk and branches. The showy, pendant clusters of fragrant, white flowers, which are produced in profusion in May, are followed by small pods, which are long persistent and add to its attractiveness during the deciduous season. It is easily transplanted, stands pruning well and can be freely reproduced from seed. It should be spaced 30 feet.

One of the most desirable ornamental trees for street planting in this State on account of its clean foliage, slender, upright habit, it has however never been used as a street tree and only in the most limited way for ornamental planting. While not so large as either yellow locust or Kentucky coffee tree, it is far more desirable than the former on account of its greater symmetry and better health and more so than the latter on account of the shape of its crown and the more uniform density of its canopy.

CHESTNUT (*Castanea dentata*).—This native tree makes one of the most desirable large-sized shade trees that can be used in the western third of this State, making rapid growth especially in youth and attaining a great age. The slightly tapering trunk with smooth dark gray bark in youth and furrowed bark in old specimens is excurrent in young trees, forming an oval crown which gradually becomes very broad and spreading. It prefers a well-drained, loamy soil of good quality. It is very easily transplanted and no American tree can endure as vigorous pruning in old specimens as the chestnut. It stands storms well and is free from leaf diseases, but the wood of the trunk is attacked by borers, which, however, seldom injure its vitality and the bark is sometimes affected by a fungus which kills the tree, especially below 2000 feet elevation. The foliage is dense and dark green; the flowers in dense white spikes appear in June and July, and the fruit, in prickly burrs, ripens and falls in September. The chestnut should be spaced not less than 40 feet. See Pl. IX.

On account of its large prickly burrs and ill-scented flowers the chestnut is not suitable for planting on streets very close to dwellings or to overhang sidewalks. It makes a desirable tree, however, for central

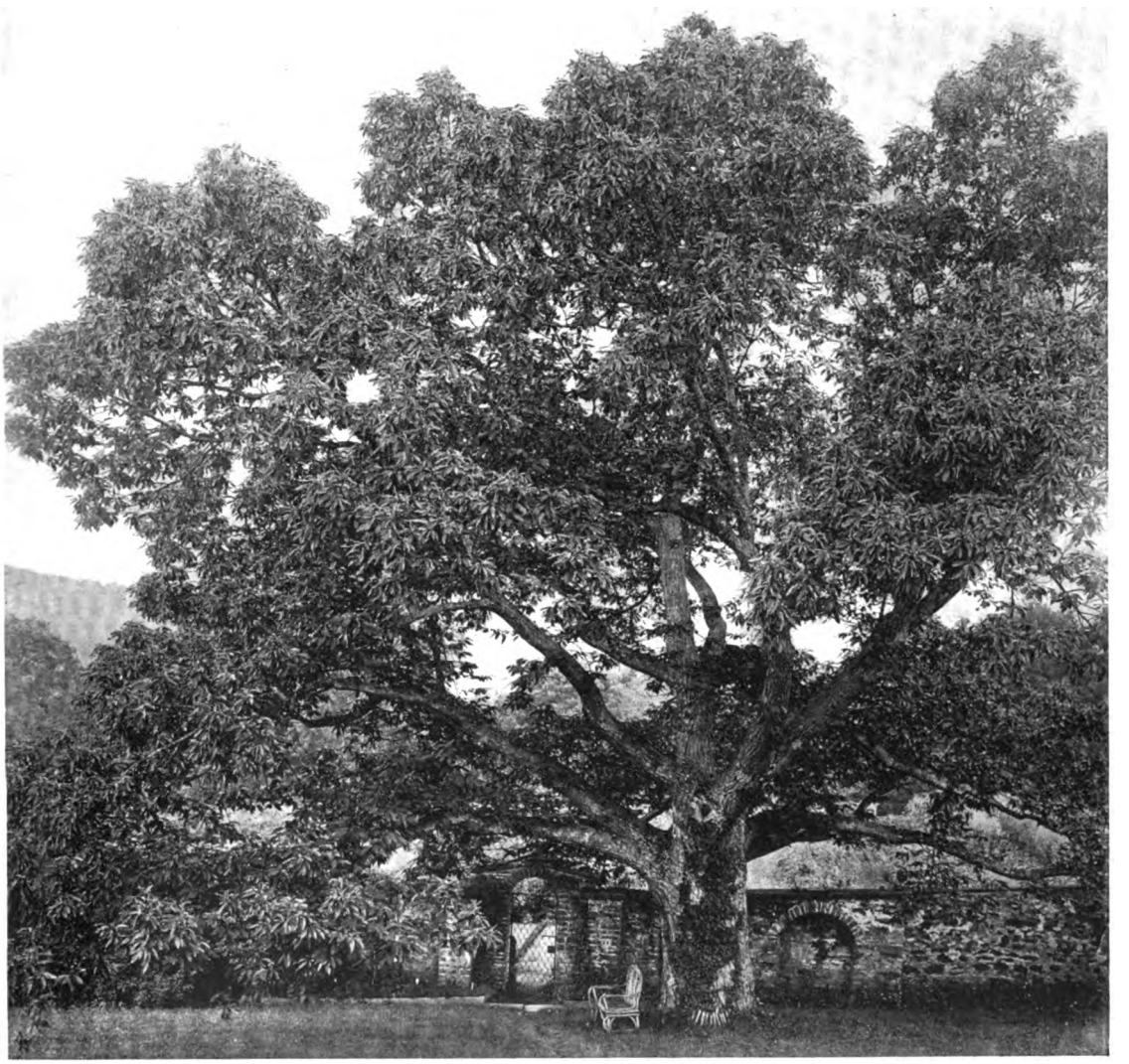
planting in streets, for bordering driveways, for parks, and especially for roadsides.

BEECH (*Fagus*) is a common native tree which might with advantage be occasionally substituted for southern maple in the eastern or for sugar maple in the western portion of the State, when it is desired to secure a dense shade. While the growth is not so rapid as that of the maple, it is satisfactory and its smooth, gray bark, net-work of finely divided flexuous twigs, make it very attractive in the winter. It is somewhat more exacting in regard to soil than the maples and has a superficial root system, which is very extensive. It stands transplanting well, however, and is very tolerant of the knife. Its tendency is to branch low, which must be regulated, and it forms a broad, spreading crown of dense bright-green foliage. There are varieties with brown-purple foliage. It is, however, better suited for the lawn than roadside planting. Trees should be spaced 35 feet.

HOP HORNBEAM (*Carpinus caroliniana*), a native tree of small size and compact crown with elm-like foliage and bark, is seldom more than 20 feet in height and reaches an age of 40 or 50 years. The growth is slow, especially in mature trees, but old trees maintain their soundness and health for a great many years. The trunk is rather long for so small a tree and the naturally broadly oval, symmetrical crown makes a dense shade. It is readily transplanted and, when necessary, stands pruning well. It is easily propagated from seed, but seedlings must be raised under light shade. Trees should be spaced 20 feet. On account of the compact habit, small size, health, and the slow growth of old specimens, it is a most desirable tree for planting narrow walks and streets, the trees requiring no trimming for many years.

OAKS (*Quercus*).—The oaks form in this State, and in fact in the other Southern States, the largest and most important group of native shade trees, there being in this State alone fifteen species which make admirable shade trees, all of which are used in some portion of the State to a greater or less extent for that purpose. The water oak section, including the water, laurel, shingle and willow oaks, probably furnishes the species which do best in the eastern and middle portions of the State, although several of the white oaks and some of the red oaks do extremely well there also. Only one water oak is native to the western portion of the State, the shingle oak, which is not so satisfactory as many of the red oaks and white oaks of that region.

With few exceptions, the oaks attain large sizes as shade trees, several of them attaining the largest size of any shade trees we have. They are of rapid growth, especially in youth, have clean foliage, are readily trans-



A FINELY DEVELOPED CHESTNUT TREE IN FLOWER, ONE OF THE MOST DESIRABLE OF THE LARGE-SIZED TREES FOR WESTERN NORTH CAROLINA. (COURTESY OF U. S. FOREST SERVICE.)

planted, stand pruning well, are not very subject to decay, while some species are resistant, and have in fact only one objectionable quality, that of their nuts, which in those species having large fruit renders them undesirable for use along paved walks on account of the attendant danger. White oaks include the white oak, post oak, chestnut oak and overcup oak. Red oaks include red oak, black oak, Spanish oak, scarlet oak and pin oak.

LIVE OAK (*Quercus virginiana*) is one of the largest of the native oaks and is well adapted for planting as far west as Raleigh and Charlotte. Its short, stout, black-barked trunk divides at a low height into several very wide-spreading, nearly horizontal branches which form in old specimens an imposing crown of great extent. The small, dark green, persistent foliage casts a moderately dense shade. In the eastern portion of the State, and especially in the southeastern, the trees are often festooned with pendant streamers of gray moss. Trees are very free from diseases and the wood is so hard and tough that in spite of the stretch of its limbs, they are seldom broken by storms.

The root system is rather wide-spreading and shallow and a sandy soil is most congenial for its rapid development, fast growth being made even to an advanced age on loose soils of moderate fertility, abundantly supplied with lime and organic matter. Even old trees endure heavy pruning. Young plants are easily secured from seed which are borne in abundance. Trees should be spaced not less than 60 feet.

The live oak is not adapted for narrow streets on account of the enormous spread of its crown, but it can be used with imposing effect for middle planting, especially on broad streets, as has been done at Southport, and less advantageously for lateral planting along broad walks. Since the growth of the crown is so largely lateral, its dignity of proportion can only be secured where it is afforded ample space for growth and this renders it an even more desirable tree for parks and lawns of large size than for streets. It is also well adapted for roadside planting, but not adjacent to fields.

LAUREL OAK (*Quercus laurifolia*), a native of the coast, is the most extensively planted shade tree in the coastal towns. This is a slender tree, with rough gray bark, a partially excurrent trunk, and many small, spreading and ascending branches and branchlets, forming an oval or broadly oval crown. It attains a height of 50 to 60 feet and an age of more than 50 years. The twigging is finely divided, flexuous and graceful, and the dark green, shining, nearly evergreen foliage casts a dense shade. While the acorns are borne in abundance, on account of their small size, they are not objectionable. Its semi-evergreen character compensates for the tardiness with which its spring verdure appears. Its

rather shallow, fibrous root system develops rapidly on moist, light soils, but it makes satisfactory growth on heavy soils, if not too dry. None of the oaks root with more ease or can be more heavily pruned. It is free from leaf diseases, but unless the exposed heart wood is protected after pruning, it is rapidly attacked by species of hydnum and other wood-destroying fungi which in the moist climate of the coast rapidly skeletonize old trees. Seedlings are easily propagated. Trees should be spaced 40 feet.

The laurel oak, which is popularly confused with the water oak, is the most desirable shade tree for the streets of cities and towns, as well as for parks in the eastern half of the State, especially where it is afforded the favorable condition of a loose, moist soil. In planting it, the young subject is usually heavily topped, being set out as a mere pole (Pl. V, A) which tends to destroy its naturally oval crown and produce a flattened, spreading one, which is often misshapen by the formation of several leaders (Pl. IV, B). The large, exposed surface where young specimens are topped frequently fails to heal over and is the seat of the entrance of many stem-destroying diseases. This tree is largely utilized in Wilmington and New Bern.

WATER OAK (*Quercus nigra*) grows in lowlands and open uplands from Morganton and Salisbury eastward, and is usually a common tree in such situations. It is a small or middle-sized tree with a short stem and roughened gray bark, and with a broadly oval or depressed globose crown formed of numerous, slender, sinuous spreading or horizontal branches. It makes a very rapid growth in youth, early acquiring a desirable size for a shade tree, and reaches an age of from 50 to 60 years.

The water oak grows well on stiff, dry upland soils, although its preference is for looser and moister soils. Transplanted specimens root easily and grow freely. It stands pruning very well and young specimens, when permanently set, are usually cut back to a mere stem, entirely destroying the leader and producing a much flattened crown. The foliage bears a general resemblance to that of the laurel oak, but it is of a duller green color, somewhat larger and is usually entirely deciduous, exceptional specimens only retaining a few green leaves on protected or vigorous shoots. It is less regular in form than the laurel oak, a smaller tree and one better adapted for narrow streets and for dry and heavy soils and for this reason better suited for the middle portion of the State. It is similar to it in arboricultural characters. Trees should be spaced 30 feet.

WILLOW OAK (*Quercus phellos*) is common throughout the middle portion of the State and occurs to a less extent in the eastern portion. It is a slender tree, of very rapid growth, especially in youth and well sus-

tained when past middle age, reaching a large size, 60 to 80 feet in height and attaining an advanced age. The trunk, covered with rough, nearly black bark, is excurrent in young specimens, which have a conical crown formed of slender, rather short dropping and spreading branches. In old trees the trunk usually branches towards the top and the crown becomes more oval and round topped, but the sweeping habit of the slender lower branches is persistent. The twigging is slender and graceful. The foliage is small, bright green, willow-like, whence the name, and casts a deep shade. While more rapid growth is made on good soils, it yet does well on close dry ones. It roots very easily, which enables large specimens to be transplanted in spite of its rather deeply seated roots. It recovers rapidly from very heavy pruning even when old and so readily in young specimens that even after heavy topping a normal leader is usually at once developed. Care should always be taken, however, to prevent the formation of false leaders which will destroy the crown's symmetry. Trees should be spaced 40 feet.

On account of its erect shape and pleasing foliage, rapid healthy growth and adaptability to heavy, clay soils, the willow oak makes one of the most desirable shade trees for the middle portion of the State, and is extensively planted in several towns. Tryon and Church streets in Charlotte, which are planted with this tree, deserve to rank among the most beautiful in the State.

SHINGLE OAK (*Quercus imbricaria*), a small tree growing along streams in many portions of the mountains, has a habit much like that of the water oak, and makes a small but desirable tree for street planting in the western portion of the State. It is the smallest oak of that region which is suitable for a shade tree. It seldom reaches a height of more than 30 feet and requires a spacing of not less than 25 feet.

WHITE OAK (*Quercus alba*), the most common tree throughout the State, growing on all classes of soils, is of slow growth, although the rate is well sustained to an advanced age, reaching a very large size, from 70 to 100 feet high, and becoming more than a century old. While the trunk is excurrent in young specimens, it gradually branches after passing middle age, the shape of the crown changing from conical in early youth to depressed globose in age, with long wide-spreading or horizontal branches. While the twigging is not so abundant or finely divided as it is in the water oaks, it is more so than in any other white oak or any of the red oaks. The leaves, which appear rather late in April after the delicate pale yellowish-green flowers, are, when unfolding, of a soft silvery green tinged with rose. The dense bright green, mature foliage droops from the ends of the twigs and becomes in late autumn dark crimson and

red, falling tardily, many leaves on the lower branches persisting through the winter. The white oak is easily transplanted and stands pruning better than any of the large red and white oaks, except the swamp chestnut oak. The foliage is clean and free from disease and it maintains its health and vigor to an advanced age. Trees should be spaced not less than 80 feet, if unrestricted growth is to be permitted.

On account of its slow growth in youth and very large size and the wide-spreading crown of old specimens, the white oak is not an entirely satisfactory tree for general street planting, although if used with discretion, it has its place and will amply justify the time required for it to attain its perfection. It is bordering wide avenues and in parks or on grounds of ample extent where its majestics crown and massive trunk can attain their full proportions that the white oak shows to fullest advantage.

SWAMP CHESTNUT OAK (*Quercus michauxii*), frequently found along streams and in swamps east of Salisbury, is a tree of scarcely less size and dignity than the white oak and is of far more rapid growth, especially in youth.

The foliage, while larger than that of the former and a slightly lighter green, droops from the twigs in the same manner and colors in autumn even more brilliantly. The branchlets are stouter and the twigging less abundant than in the white oak, and in favored localities the height and spread of the crown equal the dimensions of the white oak. Its preference is for a moist, loose soil, and abundant root room, but even on heavy dry clays it makes more rapid growth in youth than the white oak. The acorns are very large and occasionally are borne in great abundance, which is a drawback to planting beside paved walks. For middle parking strips, wide avenues or roadside planting, it is among the most desirable species. It is easily propagated from seed and stands vigorous pruning better than any other of the large white or red oaks.

NORTHERN RED OAK (*Quercus rubra*) is a common tree in the mountains of this State and frequent in cool hollows as far east as Raleigh and Charlotte.

This tree scarcely seems to be desirable east of Morganton. In the mountains, however, where it passes under the local names of *water* and *mountain oak*, it should be considered among the choicest oaks. It attains a very large size, making rapid growth to quite an advanced age, and while there are no records of cultivated specimens in this State more than 30 years old, it reaches as a forest tree an age of more than 200 years, and a height of more than 100 feet with a crown spread exceeding 60 feet, and it can reasonably be expected that in favored locations the red oak will reach proportions in the western part of this State

nearly equal to those of the white oak in the midland counties. The twigging is rather coarse, angular and open, and the ample foliage, of a pleasing dark bluish green, which in autumn becomes dull red. Trees root easily and stand pruning well. Both foliage and trunk are free from diseases. The large acorns, however, are some objection to street planting. The trees should be spaced 60 feet.

SCARLET OAK (*Quercus coccinea*), common on heavy upland soils from Raleigh westward, is a slender tree with light gray bark on the trunk and branches, reaching a height of from 60 to 70 feet and an age of more than 70 years. In young specimens and until well past middle age the trunk is excurrent, and the numerous, slender, spreading, or slightly drooping branches form an oval crown. With advancing age its excurrent character is not so noticeable and the crown becomes of greater spread. The branchlets are angled and the twigging is slender and well divided. The tender green foliage of the scarlet oak is among the first to appear of any of the larger trees, much preceding that of any of the other oaks. When mature, it is of a bright glossy green and casts a moderately dense shade. In autumn its brilliant crimson, which usually remains undulled, renders the scarlet oak for several weeks one of the most conspicuous of the trees. Occasional specimens remain green with here and there a leaf or branch of vivid color until long after the frosts have deadened other verdure. It is easily transplanted, though it does not root as quickly nor always as successfully as the white oak, the red oak, or the Spanish oak. It stands pruning well until very old. Acorns are borne in abundance but they are not so large as those of the red oak and are not as objectionable along streets. Seedlings are easily raised. Trees should be spaced 45 feet. Scarlet oak is known throughout this State by the names of pin oak or Spanish oak.

On account of its clean trunk, glossy foliage, brilliant autumnal coloring and the lateness with which it holds its leaves, the scarlet oak is one of the most desirable, if not the most desirable, red oak for a street tree, and while it is but little planted, there is no reason why it should not be extensively used.

BLACK OAK (*Quercus velutina*) is found throughout the State and is a large and rapid-growing tree with habit and foliage quite similar to that of the red oak in most respects, but inferior to the red oak for planting west of Salisbury. Many of the original large trees in the groves of public grounds, etc., in the middle portion of the State are of this species. With so many other choicer species from which to make selection, the black oak has little to commend it for general planting. The largest and tallest trees on the capitol grounds at Raleigh are black oaks.

SPANISH OAK (*Quercus digitata*) is common in this State east of the Blue Ridge, and is known in this State exclusively by the name of red oak. It is a very large tree of rapid growth, attaining a height of 70 to 80 feet, and an age of more than 100 years. The trunk is stout and covered with nearly black, rough bark, while the dome-shaped crown of old specimens is of large dimensions. The ample foliage, dark blue-green above and tawny beneath, is pendant in clusters from the tips of the twigs. The leaves, like those of the black oak, are of an unattractive brownish-green color when appearing in spring, as are also the flowers, and they lack the autumnal brilliancy which characterizes the foliage of several of the other species. While not extensively planted, there are many large specimens to be seen on streets and on public grounds in middle and eastern Carolina. Many of these, however, are original forest trees which have been permitted to remain. While the general health of the tree is good, its foliage frequently attracts a large caterpillar in great numbers which detracts considerably from its value. It is of very rapid growth, easily transplanted, and endures the heaviest pruning, even when of a large size. Occasional trees are to be seen nearly 100 feet high and with trunks 3 or 4 feet through. Several large specimens stand in the capitol grounds at Raleigh. This tree is also known as southern red oak.

PIN OAK (*Quercus palustris*), a native of northeastern United States, is a middle-sized tree with drooping lower branches forming a conical crown in youth, which becomes oval in old age. When young the trunk is excurrent but divides towards the top in old trees. The twigging is fine and abundant, and the small, deeply lobed, bright green foliage is extremely attractive. It makes a rather dense shade and its autumnal coloring is nearly as brilliant as that of the scarlet oak. It is easily transplanted and stands pruning well and its general health is good. It is considered the most desirable oak for northern planting, and would undoubtedly be a favorite in the extreme western portion of this State. It resembles in habit the willow oak and is in no way superior to that for use where the willow oak will grow. A few have been planted in the western portion of the State, to which region it is most suited, but has few if any points of superiority over the scarlet oak.

GINKGO is a Japanese tree, several specimens of which have already been planted in the eastern portion of this State. It is a slender tree having an excurrent stem covered with light brown bark. The crown is narrowly or sometimes broadly conical, and rather loosely branched. The small delicate fern-like foliage forms a thin canopy, only partially feathering the stout branchlets. The orange fruit about half an inch in diameter is often borne in abundance on large trees, and adds to their attract-

iveness during the late fall; the odor however makes it unpleasant when planted near dwellings. The chief attraction the ginkgo has during the winter is its conical crown and stout bright brown horizontal twigs, with their short spur-like branchlets. It is readily transplanted but does not stand pruning well and the leader should not be cut beyond the season's growth on account of the risk of destroying the shape of the crown. It is easily propagated from seed which as well as young plants can be secured from nurserymen.

There are few trees better suited for formal avenues than the ginkgo, and while its use as a general street tree is restricted, it can be effectively placed in central parking strips and on wide walks.

SYCAMORE (*Platanus*), a common native tree, is one of our largest (becoming 70 to 80 feet in height), and most rapidly growing trees, forming in youth a broadly pyramidal crown, which becomes massive and dome-shaped in old specimens. The trunk is stout, tapering and excurrent until well past middle age, and is covered like the branches with pale olive-brown and nearly white bark which peels in thin, irregular layers, producing an attractive mottled appearance. The twigging is rather abundant and slender, and the large leaves, dark gray green above and whitened beneath, form a moderately dense canopy.

The sycamore roots extremely easy and large specimens are readily transplanted; and there is no other species forming an excurrent stem which can be heavily topped when of large size and have the crown so perfectly replaced as this. It prefers loose moist soils. The wood decays rapidly on exposure and it is difficult to prevent large specimens from forming hollows. In many portions of the United States its value as a shade tree has been much lessened by a fungus which attacks the twigs. So far, however, trees have not been thus injured in this State. It is readily propagated both from seed and cuttings and deserves to rank as one of our most valuable rapidly growing shade trees. The heavy, dusty down which the leaves of young trees shed in the spring is considered to render it undesirable for planting near schools, churches, etc. Trees should be spaced 50 feet.

ORIENTAL PLANE (*Platanus orientalis*), a tree originally from Asia Minor, is similar to the native sycamore, but grows less rapidly, has leaves more deeply lobed and its petioles are conspicuously reddened. It is, however, a tree of rapid growth and forms a straight, tapering trunk and large pyramidal crown which gradually becomes rounded with age. It stands pruning well and is easily transplanted. On account of its freedom from the fungus which affects the foliage of the native species, it is regarded in the northeastern States as a more desirable tree. It has

been extensively utilized on the streets of Biltmore in this State, where it has proven satisfactory, but so far it has shown no point of superiority for general planting in this State above the native tree. Trees should be spaced 50 feet.

POPLARS (*Populus*) form a large group of extremely rapid growing but comparatively short-lived trees. Most of them have symmetrical, conical crowns and deltoid, tremulous foliage. While very desirable where it is necessary to secure quick shade either on streets, for screening or for other purposes, few of them are suitable for use as permanent trees for general street planting. The native species are known as cottonwoods, Carolina, or necklace poplars, and while they have several minor differences, they agree in the general conical shape of the long crown and extremely rapid growth. For deep sandy lands, for most part destitute of tree growth, the Carolina poplar serves a good purpose, as in Moore County, at Southern Pines and other points. All the species root extremely easy and can be readily propagated from cuttings, or layers, as well as from seed, except the Lombardy, which does not produce seed in this country.

LOMBARDY POPLAR (*Populus nigra italica*), a tree with a short trunk, narrowly conical crown and erect branches, is well known in North Carolina. It is longer lived than many other species of poplar, and on moist soil attains a height of more than 80 feet, and trees of more than 100 feet are recorded. The leaves protrude comparatively early, and last later in autumn than those of other poplars. It is effectively used for a certain class of planting, especially where it is desirable to secure a quick shade, since the growth is extremely rapid. While it does better on moist soils than on dry ones, it will grow in any portion of this State from the coast to the high mountains. It is propagated only from suckers or cuttings and the trees should be spaced 15 feet apart (Pl. X).

BOLLE POPLAR (*Populus alba bolleana*), has the same fastigiate habit as the Lombardy poplar and is more desirable than that tree on account of its freedom from suckers, although its leaves appear about a week later than those of the Lombardy. It is propagated only by layers and cuttings. If planted at all in this State, it is only sparingly. Plants can be secured from reliable nurserymen.

BALSAM POPLAR (*Populus balsamifera*) forms a narrow, pyramidal crown with ascending branches and stout open twiggage. The large, bright green heart-shaped leaves diffuse a fragrant balsamic odor as they unfold in late spring. The buds are large and glossy, resinous and fragrant. It grows well on wet soils and is suitable for planting, especially along roads following the banks of streams, throughout the western por-

ROWS OF LOMBARDY POPLARS WITH NARROWLY CONICAL CROWNS AND ERECT BRANCHES. IT CAN BE EFFECTIVELY USED FOR A CERTAIN CLASS OF PLANTING, ESPECIALLY WHERE IT IS DESIRABLE TO SECURE A QUICK SHADE. SINCE THE GROWTH IS EXTREMELY RAPID.

tion of the State. Trees are readily propagated from suckers or cuttings which form an extensive though shallow root system. Trees should be spaced 30 feet.

NECKLACE POPLAR (*Populus monilifera*) is a tree indigenous to our swamps but now in general cultivation around towns. It makes even on poor soils a large tree 70 or more feet in height, with a short trunk and very large, narrowly conical crown. The growth is extremely rapid, trees frequently attaining a height of 30 feet in ten years from a cutting. The trunk is excurrent and its bark, except at the base, where nearly black, is a pale gray as well as that on the rather numerous ascending branches. The large deltoid foliage appears very late, the trees being naked except for the fruit catkins when all other trees are green and falls correspondingly early in autumn, after turning a dull brown. In order to avoid the objectionable cotton floats which bear the seed, only the male or pistillate form should be planted. Easily propagated by cuttings.

CAROLINA POPLAR (*Populus deltoides*) is a native tree, frequently planted. Although smaller than the preceding, it is similar in habit and cultural characters. The mobile leaves are smaller and appear two weeks earlier in the spring, which adds to its desirability. In spite of their large crowns, both species cast a light shade. The foliage begins falling early in September and the trees are frequently entirely bare before other species have begun shedding. They early reach maturity, usually within twenty-five years, and decline with great rapidity. Both species endure heavy pollarding, but it is apt to injure the symmetry of the crown. We have no other trees which will attain the same size in so short a time, and the chief point in their favor is their extremely rapid growth enabling shade to be secured in a few years.

GOLDEN-BARK WILLOW (*Salix alba vitellina*) is one of the most desirable and rapid growing willows. It forms a broad, spreading crown and has an abundance of slender, glossy, deep green foliage. In winter it is especially attractive on account of its bright yellow-brown barked branches and dense mass of slender, bright colored twigs. There are few very rapid growing trees which would be more desirable for moist soils in the mountains of this State. It is rather short-lived, however, and will probably not become older than 40 years. It stands heavy pollarding and can be readily raised from cuttings.

Our native willow does not make a desirable shade tree, although it is sometimes planted, and the same is true of the weeping willow, which is suitable only for lawns or for planting along river roads and water fronts.

TREES SUITABLE FOR DRY SOILS.

Of the trees described above the following will be found among the best growers on very dry soils such as sand-hills: Cottonwood, Carolina Poplar, Lombardy Poplar, Russian Mulberry, Water Oak, Willow Oak, Live Oak, Olive, Magnolia, Mockorange, Pecan and Spanish Oak (Southern Red Oak). In the extreme southeastern portion of the State, near the coast, the Palmetto can probably be grown, but it will be more of an ornamental tree than a shade tree.

TREES SUITABLE FOR WET SOILS.

On cold, wet or poorly-drained soils, such as pipe-clay bottoms and swampy land, the following trees will be found the most satisfactory: Red Maple, Swamp Ash, Pin Oak, Laurel Oak, the Gums and Cypress.

PUBLICATIONS

OF THE

NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*

8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

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17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*

18. A List of Elevations in North Carolina, by Joseph Hyde Pratt. *In preparation.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

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